

United States Department of Energy

Savannah River Site

**Record of Decision
Remedial Alternative Selection for the
L-Area Oil and Chemical Basin (904-83G)
and L-Area Acid/Caustic Basin (904-79G) (U)**

**WSRC-RP-97-143
Revision. 1
July 1997**

**Westinghouse Savannah River Company
Savannah River Site
Aiken, South Carolina 29808**



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**RECORD OF DECISION
REMEDIAL ALTERNATIVE SELECTION (U)**

L-Area Oil and Chemical Basin (904-83G) and L-Area Acid Caustic Basin (904-79G)

**WSRC-RP-97-143
Revision. 1 July 1997**

**Savannah River Site
Aiken, South Carolina**

Prepared by:

**Westinghouse Savannah River Company
for the
U. S. Department of Energy Under Contract DE-AC09-96SR18500
Savannah River Operations Office
Aiken, South Carolina**

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DECLARATION FOR THE RECORD OF DECISION

Unit Name and Location

L-Area Oil & Chemical Basin (904-83G) and L-Area Acid/Caustic Basin (904-79G)

Savannah River Site

Aiken, South Carolina

The L-Area Oil & Chemical Basin (LAOCB) and L-Area Acid/Caustic Basin (LAACB) source Operable Unit (OU) is listed as a Resource Conservation and Recovery Act (RCRA) 3004(u) Solid Waste Management Unit/Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) unit in Appendix C of the Federal Facility Agreement (FFA) for the Savannah River Site (SRS).

Statement of Basis and Purpose

This decision document presents the selected remedial alternative for the LAOCB/LAACB located at the SRS south of Aiken, South Carolina. The selected alternative was developed in accordance with CERCLA, as amended, RCRA, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record File for this specific RCRA/CERCLA unit.

Assessment of the Site

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

The preferred alternatives for the LAOCB source OU are Alternative P-3: In-situ Stabilization and Disposal in the LAOCB for remediating the LAOCB pipeline, and Alternative S-4: In-situ Stabilization and Capping of the LAOCB for remediating the LAOCB soil. These alternatives will meet remedial action objectives by eliminating the potential ingestion of soils and produce grown in soils, and reduce/minimize direct radiation exposure and potential future impacts to groundwater. The capped area will be maintained and Institutional Controls will remain in place as long as the waste remains a threat to human health or the environment.

The preferred alternative for the LAACB is No Action. The LAACB will be backfilled with native soil and vegetation will be established in a similar fashion to the clean closure of the F-, H-, K-, and P-Acid/Caustic Basins (WSRC, 1995a).

Groundwater south of L Reactor has been impacted by several source OUs including the LAOCB. The groundwater has been identified as a separate OU, as discussed in Section IV of this ROD, and will be addressed in a separate groundwater ROD.

Implementation of the preferred alternatives will require both near- and long-term actions which will be protective of human health and the environment. For the near-term, signs will be posted at the LAOCB which indicate that this area was used for the disposal of radioactive and hazardous substances. In addition, existing SRS access controls will be used to maintain the use of this site for industrial activities only. Near-term actions at the LAACB will consist of backfilling and seeding to establish vegetation and posting to indicate that this area was used for the disposal of hazardous substances.

In the long-term, if the property is ever transferred to non-Federal ownership, the U.S. Government will create a deed for the new property owner which would contain information in compliance with Section 120(h) of CERCLA. The deed would include a notification disclosing former waste management and disposal activities as well as remedial actions taken on the site, and any continuing groundwater monitoring commitments. The deed notification would, in perpetuity, notify any potential purchaser that the property has been used for the management and disposal of radioactive and hazardous substances.

The deed would also include deed restrictions precluding residential use of the property. However, the need for these restrictions may be reevaluated in the event that contamination no longer poses an unacceptable risk under residential use. In addition, if the site is ever transferred to non-Federal ownership, a survey plat of the area will be prepared, certified by a professional land surveyor, and recorded with the appropriate Barnwell County recording agency (the LAOCB/LAACB OU is located in northern Barnwell County).

The post-ROD document, the Corrective Measures/Remedial Design Work Plan (CM/RD WP), will be submitted to the U.S. Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (SCDHEC) within approximately one month after the issuance of the ROD. The CM/RD WP will contain a summary description of the scope of work for the remedial action design, detailed implementation/submittal schedule for subsequent post-ROD documents, and an anticipated field activities start date. The regulatory review period, SRS revision period, and final

The SCDHEC has modified the SRS RCRA permit to incorporate the selected remedy.

Statutory Determination

Based on the LAOCB/LAACB RCRA Facility Investigation/Remedial Investigation (RFI/RI) Report and the Baseline Risk Assessment (BRA), the LAOCB source OU poses significant risk to human health and the environment. Therefore, a determination has been made that in-situ solidification/stabilization (S/S) of the pipeline, excavation and placement of pipeline in the LAOCB, and in-situ S/S and capping of the LAOCB is protective of human health and environment for the contamination remaining in the LAOCB pipeline and LAOCB soil. In-situ S/S and capping will result in the protection of unit groundwater through the stabilization of unit constituents of concern (COCs), and will be protective of *on-unit* human and ecological receptors by shielding radiation exposure and preventing the assimilation of unit COCs. The selected remedy is protective of human health and the environment, complies with Federal and State of South Carolina requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technology to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Based on the LAOCB/LAACB RFI/RI Report and the BRA, the LAACB source OU poses no significant risk to human health and the environment. Therefore, a determination has been made that a No Action alternative is appropriate for the LAACB. The No Action alternative will be protective of human health and the environment.

Section 300.430 (f)(4)(ii) of the NCP requires that a five year review of the ROD be performed if hazardous substances, pollutants, or contaminants remain in the waste unit. The SRS RCRA permit is reviewed every five years, and was most recently renewed on September 5, 1995. Because this remedy will result in hazardous substances remaining on-site above health-based levels, the three Parties [U.S. Department of Energy (DOE), SCDHEC, and EPA] have determined that a Five Year Review of the ROD for the LAOCB/LAACB will be performed to ensure continued protection of human health and the environment.

7/24/97
Date

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**DECISION SUMMARY
REMEDIAL ALTERNATIVE SELECTION (U)**

L-Area Oil and Chemical Basin (904-83G) and L-Area Acid Caustic Basin (904-79G)

WSRC-RP-97-143

Revision. 1

July 1997

**Savannah River Site
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LIST OF ACRONYMS AND ABBREVIATIONS

%	percent
ANS	American National Standard
ARARs	Applicable or relevant and appropriate requirements
BRA	Baseline Risk Assessment
CAB	Citizens Advisory Board
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	Curies
CM/RDR/RAWP	Corrective Measures/Remedial Design Report/Remedial Action Work Plan
CM/RDWP	Corrective Measures/Remedial Design Work Plan
CMS	Corrective Measures Study
COC	Constituent of Concern
COPC	Constituent of Potential Concern
CrVI	chromium VI
CSM	conceptual site model
DOE	U.S. Department of Energy
dpm	disintegrations per minute
DQO	Data Quality Objectives
EPA	U.S. Environmental Protection Agency
ERD	Environmental Restoration Department
FFA	Federal Facility Agreement
FS	Feasibility Study
ft	feet
GOU	Groundwater Operable Unit
HI	Hazard index
HQ	Hazard quotient
LAACB	L-Area Acid/Caustic Basin
LAOCB	L-Area Oil and Chemical Basin
MEK	methyl ethyl ketone
mg/kg	milligrams per kilograms
msl	mean sea level
NCP	National Oil and Hazardous Substances Contingency Plan
NEPA	National Environmental Policy Act
NESHAPS	National Emissions Standards for Hazardous Air Pollutants
NPL	CERCLA National Priorities List
NTS	Nevada Test Site
OSHA	Occupational Safety and Health Administration
OU	operable unit
PCB	polychlorinated biphenyls
pCi/g	picoCuries per gram
PP	Proposed Plan
RBC	Risk Based Concentration
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RG	Remedial Goal
RI	CERCLA Remedial Investigation
ROD	Record of Decision
S/S	stabilization/solidification
SB	Statement of Basis
SCDHEC	South Carolina Department of Health and Environmental Control

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

SCHWMR	South Carolina Hazardous Waste Management Regulations
SDCF	soil/debris consolidation facility
SRS	Savannah River Site
SVOC	semivolatile organic compound
TBC	To Be Considered
TCLP	Toxicity Characteristic Leaching Procedure
UMTRCA	Uranium Mill Tailings Radiation Control Act
USC	unit specific constituent
VOC	volatile organic compounds
WSRC	Westinghouse Savannah River Company

I. SAVANNAH RIVER SITE AND OPERABLE UNIT NAME, LOCATION, DESCRIPTION, AND PROCESS HISTORY

Savannah River Site Location, Description, and Process History

The Savannah River Site (SRS) occupies approximately 310 square miles of land adjacent to the Savannah River, principally in Aiken and Barnwell counties of western South Carolina. SRS is a secured U.S. Government facility with no permanent residents, and is located approximately 25 miles southeast of Augusta, Georgia and 20 miles south of Aiken, South Carolina (Figure 1).

SRS is owned by the U.S. Department of Energy (DOE). Management and operating services are currently provided by Westinghouse Savannah River Company (WSRC). SRS has historically produced tritium, plutonium, and other special nuclear materials for national defense and the space program. Chemical and radioactive wastes are by-products of nuclear material production processes.

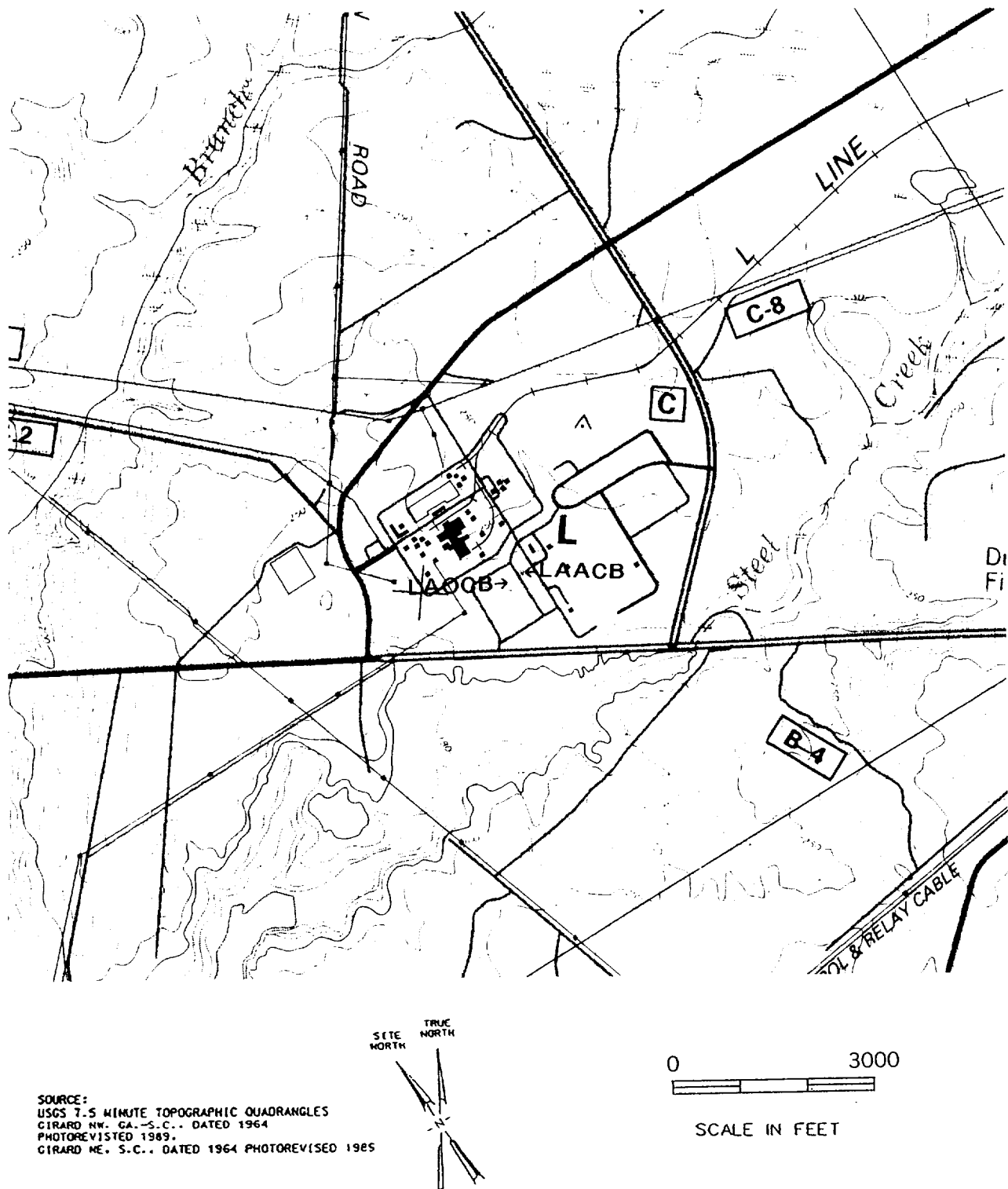
Operable Unit Name, Location, Description, and Process History

The Federal Facility Agreement (FFA) for the SRS lists the L-Area Oil and Chemical Basin/Acid Caustic Basin (LAOCB/LAACB), 904-83G and 904-79G, as a Resource Conservation and Recovery Act/Comprehensive Environmental Response, Compensation and Liability Act (RCRA/CERCLA) unit requiring further evaluation, using an investigation/assessment process that integrates and combines the RCRA Facility Investigation (RFI) process with the CERCLA Remedial Investigation (RI) to determine the actual or potential impact to human health and the environment. The LAOCB and LAACB are located south of L Area in an area of low to moderate relief (Figure 2). They are situated on the southern flank of a hill approximately 300 feet (ft) south of the L-Area perimeter fence and 1,250 ft north of L Lake. The area lies at an elevation of approximately 235 ft above mean sea level (msl), and 45 ft above the elevation of L Lake. Surface water runoff in L Area drains southward to L Lake via overland flow and small intermittent stream channels and drainage ditches.

Direct precipitation (rain, snow, ice, etc.) is currently the only source for basin water. The LAOCB and LAACB both act as intermittent, wet-weather ponds. The LAOCB contains water at most times while the LAACB is more frequently dry. Overflow from the LAOCB would drain southward to L Lake as described above. Overflow is not probable because the capacity of the basin is approximately four times the volume of water attributable to annual precipitation. Wastewater has never been reported to have

A detailed map of the Savannah River Site, showing its location relative to Georgia, South Carolina, and Alabama. The map includes the SRS boundary, major rivers (Savannah River, Upper Three Runs, Middle Three Runs, Lower Three Runs), and various areas (A and M, B, C, CS, D, F, H, K, L, P, R, S, T, Z). It also shows the Savannah River Forest Station, Par Pond, L-Lake, and the LAOCB/LAOCB Branch. Surrounding counties (Barnwell, Allendale) and states (Georgia, South Carolina, Alabama) are labeled. A compass rose indicates True North and Site North. The map is labeled 'NOT TO SCALE'.

Figure 2. Topographic Map of the LAOCB/LAACB and Surrounding Area



overflowed from the LAOCB. The LAACB was designed to discharge basin water through an overflow pipe located at the southern end of the basin. A discharge ditch was also constructed to receive water from the overflow pipe. The overflow pipe is positioned to operate only at very high water levels to prevent overtopping the basin berm.

LAOCB

The LAOCB was designed and constructed as an unlined seepage basin in 1961 for the purpose of disposing of small volumes of wastes that were not appropriate for discharge to local streams, regular seepage basins, or the 200-Area waste management system. The LAOCB measures 182 ft long by 108 ft wide at the berm with an overall area of 0.45 acres and an average depth of 12 ft. The LAOCB received waste via a bermed concrete drainage pad that was located outside the basin perimeter fence, and from a gravity flow underground pipeline (6-inch diameter steel) originating at the maintenance Hot Shop (Figure 3). The pipeline from the Hot Shop was originally constructed to extend to the L-Area Reactor Seepage Basin for an approximate total length of 750 ft. The pipeline was installed prior to the excavation of the LAOCB. When the LAOCB was constructed, all pipeline drainage was diverted to the LAOCB. The approximately 275 ft of pipeline between the LAOCB and the Reactor Seepage Basin was plugged off at each end and taken out of use. This section of the pipeline is not part of the LAOCB/LAACB OU and will be addressed as part of the L-Reactor Seepage Basin (see Section IV). In addition, a second pipeline (2-inch diameter steel), located just south of the main pipeline, extends approximately 450 ft from the Hot Shop to the LAOCB.

The exact quantity of wastewater discharged to the basin is not documented and the following summary on chemical composition of discharges is based on process knowledge. Liquid wastes consisting of small volumes of slightly radioactive oil and chemical wastewater were sent to the LAOCB from throughout SRS, but came primarily from the reactor areas. Wastes were transported to the drainage pad in tank trucks, metal drums, skid tanks, and other containers. The Hot Shop (Building 717-G) discharged decontamination wastewater containing radionuclides, detergents, and spent degreasing solvents through the pipeline to the basin. Historical records indicate that wastes from all sources contributed approximately 2.2 curies (Ci) of alpha emitters and 270 Ci of nonvolatile beta emitters including 0.1 Ci of strontium-90 (^{90}Sr) and 0.4 Ci of cesium-137 (^{137}Cs) (Fenimore et al., 1988).

The basin remained active until 1979 when all discharge to the basin ceased, and has remained open from 1979 to present. The LAOCB is currently surrounded by a chain link fence, posted as a radiological contamination area, and contains low-lying vegetation indigenous to the area that has grown back since removal in 1993 (Figure 4).

Figure 3. Unit Layout and RFI/RI Sampling Locations of the LAOCB/LACB

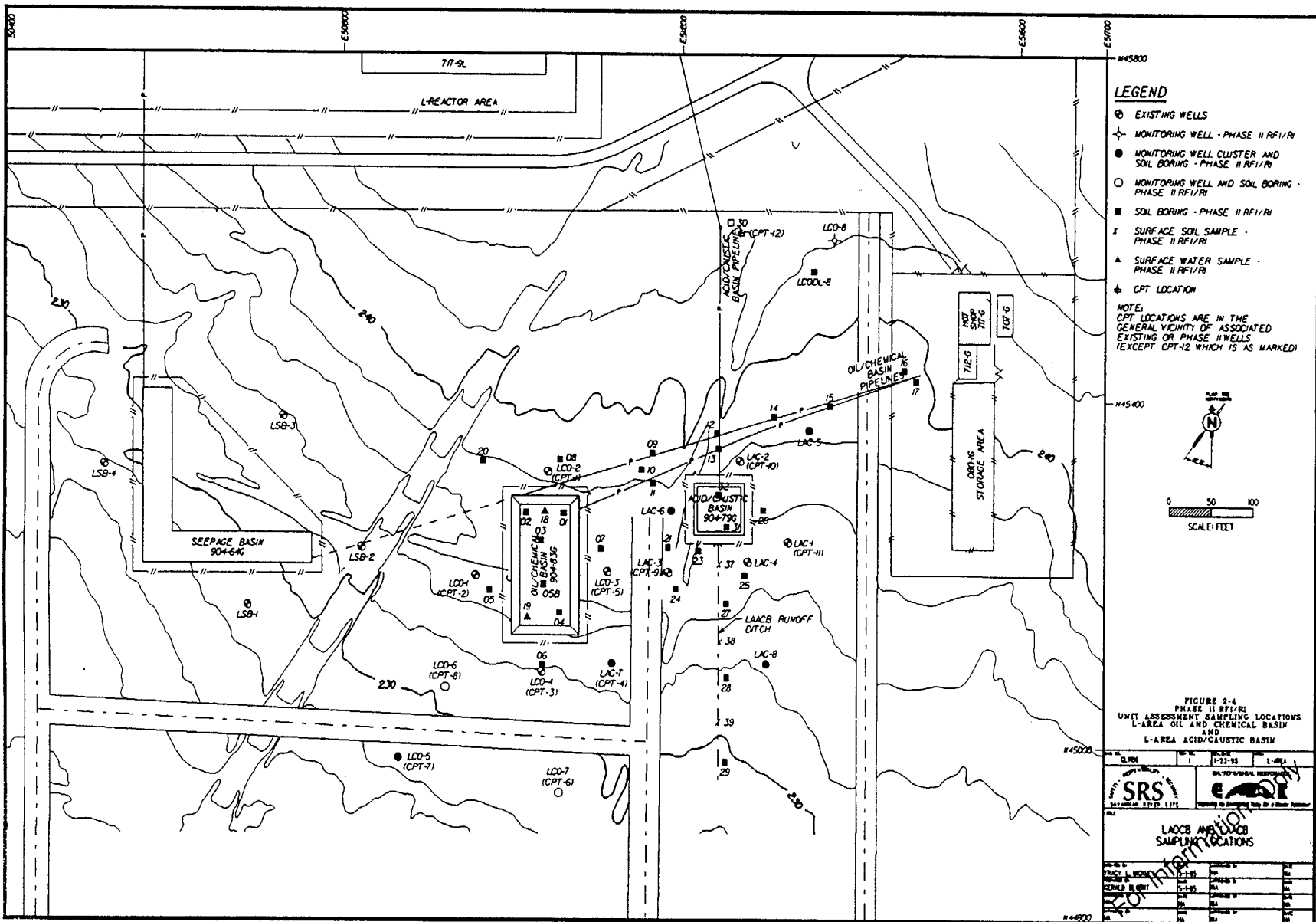
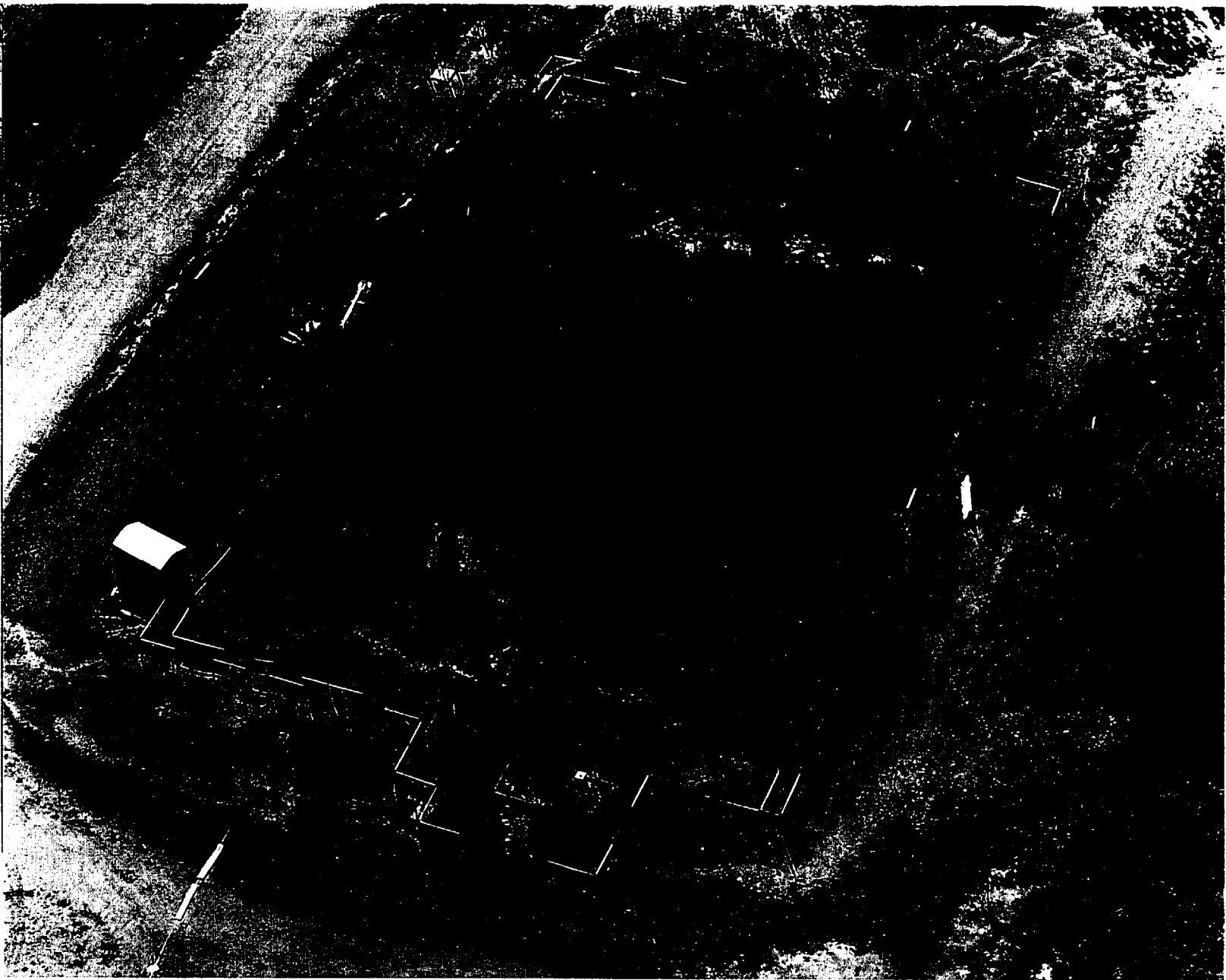


Figure 4. Aerial Photograph of LAOCB



LAACB

Acid/caustic basins were constructed in F, H, K, L, P, and R Areas between 1952 and 1954 as unlined basins. These basins received dilute sulfuric acid and sodium hydroxide solutions used to regenerate ion-exchange units in the water purification processes at the reactor and separations areas in the center of the SRS. Other wastes discharged to the basins included water rinses from the ion exchange units both before and after regeneration, steam condensate from the heaters in the sodium hydroxide storage tanks and water treatment building, and any rain that collected in the storage tank's spill containment enclosures. The basins allowed mixing and neutralization of the dilute solutions before discharge to nearby streams.

The LAACB was constructed in 1954 and received wastewater from the L-Area water treatment plant facility via a pipeline (vitrified clay) that extends approximately 1,100 ft from the water treatment facility to the LAACB (Figure 5). The LAACB and pipeline are considered a part of this operable unit (OU) and are addressed in this Record of Decision (ROD). The LAACB measures 50 ft by 50 ft with an area of 0.057 acres and an average depth of 7 ft. A berm surrounding the basin diverts overland flow away from the basin. As discussed for the LAOCB, the exact quantity of wastewater disposed of is not documented, but is known to consist primarily of dilute sulfuric acid and sodium hydroxide solutions.

The LAACB received waste from 1955 to 1968 at which time all discharge to the basin ceased, and has remained open from 1968 to present. The LAACB is currently surrounded by a barbed-wire fence, is posted as a RCRA/CERCLA unit, and contains low-lying vegetation indigenous to the area.

II. - SITE AND OPERABLE UNIT COMPLIANCE HISTORY

SRS Operational History

The primary mission of SRS was to produce tritium (^3H), plutonium-239 (^{239}Pu), and other special nuclear materials for our nation's defense programs. Production of nuclear materials for the defense programs was discontinued in 1988. SRS has provided nuclear materials for the space program, as well as for medical, industrial, and research efforts up to the present. Chemical and radioactive wastes are by-products of nuclear material production processes. These wastes have been treated, stored, and in some cases, disposed at SRS. Past disposal practices have resulted in soil and groundwater contamination.

LEGEND

■ PHASE II RFI/RI SAMPLING LOCATION
○ MANHOLE

FIGURE 2-6
UNIT ASSESSMENT SAMPLING LOCATIONS
ALONG THE
L-AREA ACID/CAUSTIC PIPELINE

DATE	BY	DATE	BY	DATE	BY
5-1-95	TRACY L. MCKLEY	5-1-95	MA	5-1-95	MA
5-1-95	GERALD BLOUNT	5-1-95	MA	5-1-95	MA
5-1-95	MA	5-1-95	MA	5-1-95	MA
5-1-95	MA	5-1-95	MA	5-1-95	MA

**PHASE II RFI/RI
SAMPLING LOCATIONS
FOR THE
L-AREA ACID/CAUSTIC BASIN PIPELINE**

ENVIRONMENTAL RESTORATION
SRS
Savannah River Site
Working the Environment Today for a Cleaner Tomorrow

SRS Compliance History

Waste materials handled at SRS are regulated and managed under RCRA, a comprehensive law requiring responsible management of hazardous waste. Certain SRS activities have required Federal operating or post-closure permits under RCRA. SRS received a hazardous waste permit from the South Carolina Department of Health and Environmental Control (SCDHEC); the permit was most recently renewed on September 5, 1995. Part IV of the permit mandates that SRS establish and implement an RFI Program to fulfill the requirements specified in Section 3004(u) of the Federal permit.

On December 21, 1989, SRS was included on the National Priorities List (NPL). This inclusion created a need to integrate the established RFI Program with CERCLA requirements to provide for a focused environmental program. In accordance with Section 120 of CERCLA, DOE has negotiated a Federal Facility Agreement (FFA) (WSRC, 1993a) with the U.S. Environmental Protection Agency (EPA) and SCDHEC to coordinate remedial activities at SRS into one comprehensive strategy which fulfills these dual regulatory requirements.

Operable Unit Compliance History

LAOCB

As previously stated, the LAOCB is listed in the FFA as a RCRA/CERCLA unit requiring further evaluation to determine the actual or potential impact to human health and the environment. An RFI/RI characterization and Baseline Risk Assessment (BRA) were conducted for the unit between 1993 and 1995. The results of the RFI/RI and BRA were presented in the RFI/RI and BRA reports. The RFI/RI and BRA reports were submitted in accordance with the FFA and the approved implementation schedule, and were approved by the EPA and SCDHEC in February 1996. The Corrective Measures Study/Feasibility Study (CMS/FS) and Statement of Basis/Proposed Plan (SB/PP) were submitted in accordance with the FFA and the approved implementation schedule, and were approved by EPA and SCDHEC in March 1997.

LAACB

As previously stated, the LAACB is listed in the FFA as a RCRA/CERCLA unit requiring further evaluation to determine the actual or potential impact to human health and the environment. An RFI/RI field characterization was conducted and documented for the LAACB at the same time as the LAOCB. The RFI/RI and BRA reports were submitted in accordance with the FFA and regulatory approved implementation schedule, and were approved by the EPA and SCDHEC in February 1996. The CMS/FS

and SB/PP were submitted in accordance with the FFA and the approved implementation schedule, and were approved by EPA and SCDHEC in March 1997.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Both RCRA and CERCLA require the public be given an opportunity to review and comment on the draft permit modification and proposed remedial alternative. Public participation requirements are listed in South Carolina Hazardous Waste Management Regulation (SCHWMR) R.61-79.124 and Sections 113 and 117 of CERCLA. These requirements include establishment of an Administrative Record File that documents the investigation and selection of the remedial alternatives for addressing the LAOCB/LAACB soils and groundwater. The Administrative Record File must be established at or near the facility at issue. The SRS Public Involvement Plan (DOE, 1994) is designed to facilitate public involvement in the decision-making process for permitting, closure, and the selection of remedial alternatives. The SRS Public Involvement Plan addresses the requirements of RCRA, CERCLA, and the National Environmental Policy Act, 1969 (NEPA). SCHWMR R.61-79.124 and Section 117(a) of CERCLA, as amended, require the advertisement of the draft permit modification and notice of any proposed remedial action and provide the public an opportunity to participate in the selection of the remedial action. The *Statement of Basis/Proposed Plan for the L-Area Oil and Chemical Basin and L-Area Acid/Caustic Basin* (WSRC, 1997a), a part of the Administrative Record File, highlights key aspects of the investigation and identifies the preferred action for addressing the LAOCB/LAACB.

The FFA Administrative Record File, which contains the information pertaining to the selection of the response action, is available at the EPA office and at the following locations:

U. S. Department of Energy
Public Reading Room
Gregg-Graniteville Library
University of South Carolina-Aiken
171 University Parkway
Aiken, South Carolina 29801
(803) 641-3465

Thomas Cooper Library
Government Documents Department
University of South Carolina
Columbia, South Carolina 29208
(803) 777-4866

Reese Library
Augusta State University
2500 Walton Way
Augusta, Georgia 30910
(706) 737-1744

Asa H. Gordon Library
Savannah State University
Tompkins Road
Savannah, Georgia 31404
(912) 356-2183

Prior to the submittal of the CMS/FS for the LAOCB/LAACB, the SRS Environmental Restoration Department (ERD) presented a focused feasibility scoping of remedial actions for the LAOCB/LAACB to the Environmental Remediation and Waste Management Subcommittee of the SRS Citizens Advisory Board. This feasibility scoping was deemed necessary because the high-risk associated with LAOCB requires that a remedial action be performed in a timely manner, and because of the technology limitations of the remedial alternatives for the mixed radioactive and hazardous wastes identified in the soil inside the basin.

The public was notified of the public comment period through mailings of the *SRS Environmental Bulletin*, a newsletter sent to approximately 3500 citizens in South Carolina and Georgia, through notices in the *Aiken Standard*, the *Allendale Citizen Leader*, the *Augusta Chronicle*, the *Barnwell People-Sentinel*, and *The State* newspapers. The public comment period was also announced on local radio stations.

The 45-day public comment period began on April 4, 1997 and ended on May 18, 1997. A public comment meeting was held on May 7, 1997. A Responsiveness Summary was prepared to address comments received during the public comment period. The Responsiveness Summary is provided in Appendix A of the ROD. It will also be available in the final RCRA Permit.

IV. SCOPE AND ROLE OF THE OPERABLE UNIT WITHIN THE SITE STRATEGY

RCRA/CERCLA Programs at SRS

RCRA/CERCLA units (including the LAOCB/LAACB) at SRS are subject to a multi-stage remedial investigation process that integrates the requirements of RCRA and CERCLA as outlined in the RFI/RI Program Plan (WSRC, 1993b). The RCRA/CERCLA processes are summarized on Figure 6. Figure 6 illustrates the investigation and characterization of potentially impacted environmental media (such as soil,

Figure 6. RCRA/CERCLA Logic and Documentation

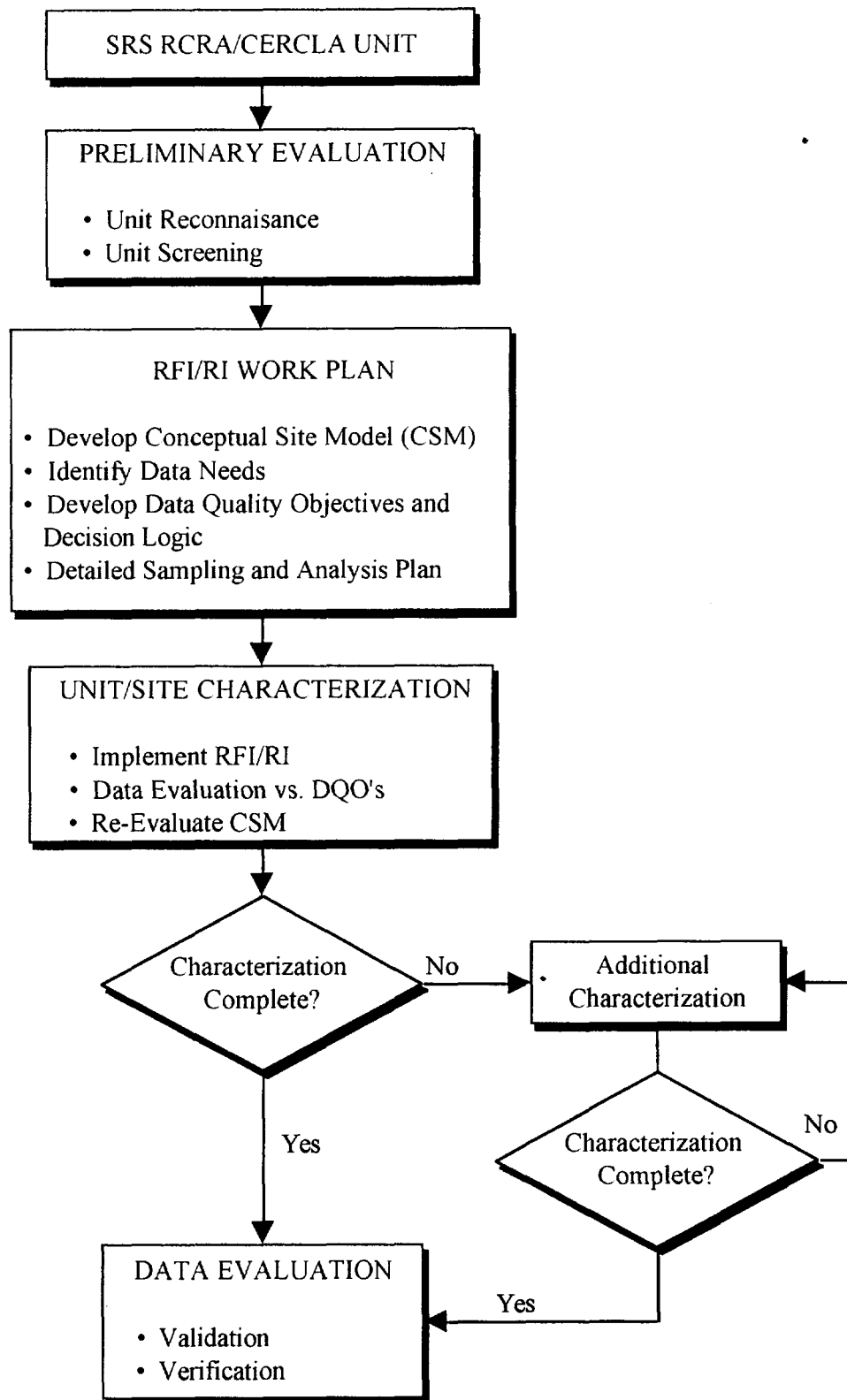
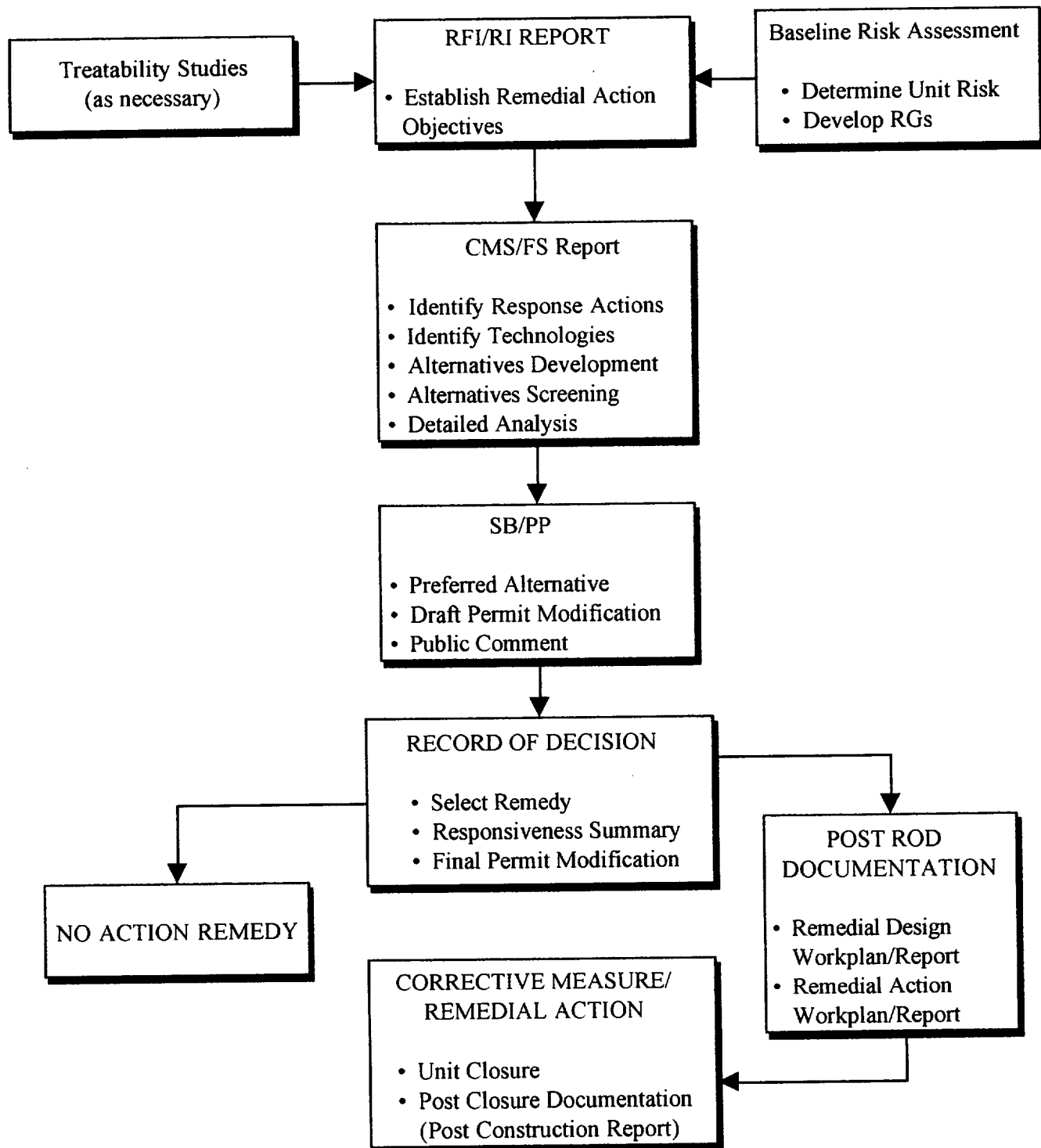


Figure 6. (continued) RCRA/CERCLA Logic and Documentation



groundwater, and surface water) comprising the waste site and surrounding areas; the evaluation of risk to human health and the local ecological community; the screening of possible remedial actions to identify the selected technology which will protect human health and the environment; implementation of the selected alternative; documentation that the remediation has been performed competently; and evaluation of the effectiveness of the technology. The steps of this process are iterative in nature, and include decision points which involve concurrence between the DOE (as owner/manager), the EPA and SCDHEC (as regulatory oversight), and the public. The RCRA/CERCLA process as applied to the LAOCB/LAACB is outlined below.

RFI/RI Work Plan

Based on the data reviewed and collected during the unit preliminary screening and process knowledge, a conceptual site model (CSM) was developed to: determine the source, primary contaminated media, migration pathways, exposure pathways, and potential human and ecological receptors. Section V provides the unit-specific CSM for the LAOCB/LAACB OU, and a summary of the characteristics of the primary and secondary sources and release mechanisms for the units as determined in the RFI/RI.

Development of the CSM facilitates the initial step of determining the nature and extent of unit contamination through the identification of data gaps using the Data Quality Objectives (DQO) process. DQOs are useful in identifying data needs associated with the sources and exposure media and in developing a sampling and analytical plan which describes the procedures for collecting sufficient data of known and defensible quality. The unit disposal and monitoring history indicated that the LAOCB/LAACB and associated pipelines are a probable contamination source that may represent unacceptable risk to human health and the environment. Multiple data needs were identified to reduce the uncertainty associated with the contamination of the LAOCB/LAACB to include the nature and extent of contamination in: (1) basin vegetation, surface water, and soils, (2) soils adjacent to the basins, (3) soils along the pipelines, and (4) groundwater in the vicinity of the basins. Consequently, to make key remedial decisions it was necessary to develop a work plan to satisfy these data needs to determine the associated risk to human and ecological receptors. The approved RFI/RI work plan for the LAOCB/LAACB (WSRC, 1993) outlined the specific characterization activities that were necessary to meet the DQOs for the LAOCB/LAACB.

Unit/Site Characterization (RFI/RI)

The primary need for the RFI/RI is to establish unit-specific constituents (USCs) that pose potential risk through various exposure routes and determine their distribution in source media associated with the unit. One of the principle requirements for determining USCs is to establish unit-specific background concentrations. Once established, the maximum values of detected constituents at the unit are screened against two-times mean background concentrations to identify constituents that exceed background. These data are used to further define the Constituents of Potential Concern (COPCs) and Constituents of Concern (COCs) during the risk assessment. In addition, these data provide the contaminant profile and mass which is necessary to determine potential contaminant migration to off-unit receptors.

The data needs for the LAOCB/LAACB RFI/RI were satisfied through the following characterization activities:

- sampling/analysis of basin surface water/sediment and subsurface soil (secondary source)
- sampling/analysis of basin perimeter surface/subsurface soil (secondary source)
- sampling/analysis of subsurface soil along pipelines (secondary source)
- sampling/analysis of basin vegetation (exposure pathway)
- sampling/analysis of groundwater (exposure pathway)
- air monitoring during sampling activities (exposure pathway)
- sampling/analysis of background vegetation, soil, and groundwater
- radiation survey of the ends of the LAOCB pipelines (secondary source)

Streamlined investigation activities and the development of innovative sampling devices to minimize worker exposure during the collection of radioactive environmental media were utilized during the RFI/RI for the LAOCB/LAACB. Blanks and duplicate samples were collected during the RFI/RI at defined frequencies and analyzed by independent, certified laboratories to provide defensible data. The results of the RFI/RI of the LAOCB/LAACB are reported and discussed in Section V.

Baseline Risk Assessment

The intent of the BRA is to develop risk information necessary to assist in the decision-making process for remedial sites. Risk from the unit/site is quantified, based on unit specific data, for current and future human and ecological receptors through multiple exposure routes as identified in the CSM. Carcinogenic risk at or above 1.0×10^{-6} (one excess human cancer in a population of one million) are considered

significant. In addition, if a hazard index (HI) is greater than 1.0 for noncarcinogenic constituents, there is concern that adverse health effects may occur.

The overall objectives of the BRA conducted for the LAOCB/LAACB were met as summarized below:

- identified the unit-specific COPCs (primarily radionuclides) and quantified the risk they pose to applicable human and ecological receptors (unacceptable risk to human health);
- determined that the LAACB does not pose a significant risk to human receptors;
- determined that the LAOCB poses an unacceptable risk to human receptors;
- determined that the LAOCB and LAACB do not pose unacceptable risk to ecological receptors;
- determined that the LAOCB and LAACB and the surrounding areas do not provide habitat for any threatened, endangered, or sensitive plant or animal species that may be impacted by unit contaminants;
- established human health COCs for the LAOCB (primarily radionuclides) that pose unacceptable risk and determined the remedial goal (RG) concentrations of chemical and radiological constituents that can remain in-situ and will be adequately protective of human health and the environment;
- established the data necessary to compare potential human health and environmental impacts of remedial actions applicable to the LAOCB and other radioactive seepage basins at SRS to include stabilization/solidification, vitrification, and removal.

A summary of the results of the BRA for the LAOCB/LAACB are presented in Section VI.

CMS/FS

The results of the RFI/RI and BRA provide the basis for establishing unit-specific remedial action objectives in the CMS/FS. Remedial action objectives for the LAOCB (including its pipelines) were developed to address: unit-specific contaminants, media of concern, potential exposure pathways, and RGs. The remedial action objectives are based on the nature and extent of contamination, threatened resources, human and environmental risk information, and the potential for human and environmental exposure. In addition, the preliminary remediation goals for the LAOCB and its pipelines were developed based upon Applicable or Relevant and Appropriate Requirements (ARARs) or other information from the RFI/RI Report and the BRA.

The methodologies used to identify and screen relevant technologies for the remediation of the waste unit followed an established process developed by the EPA. The goal of this remedy selection process is to select corrective measures/remedial actions that are protective of human health and the environment, that

maintain protection over time, and that minimize contaminant (or waste) mobility, toxicity, or volume through treatment, when possible [CERCLA 300.430 (a)(1)(I)]. The selection of a response action for the waste unit proceeded in a series of steps as defined in the NCP of November 20, 1985 (50 FR 47973) and outlined in Figure 7. In addition, the remedial alternatives were further evaluated for the LAOCB (including its pipelines) by following nine selection criteria established by the NCP:

- Overall Protection of Human Health and the Environment
- Compliance with Applicable or Relevant and Appropriate Requirements
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume Through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

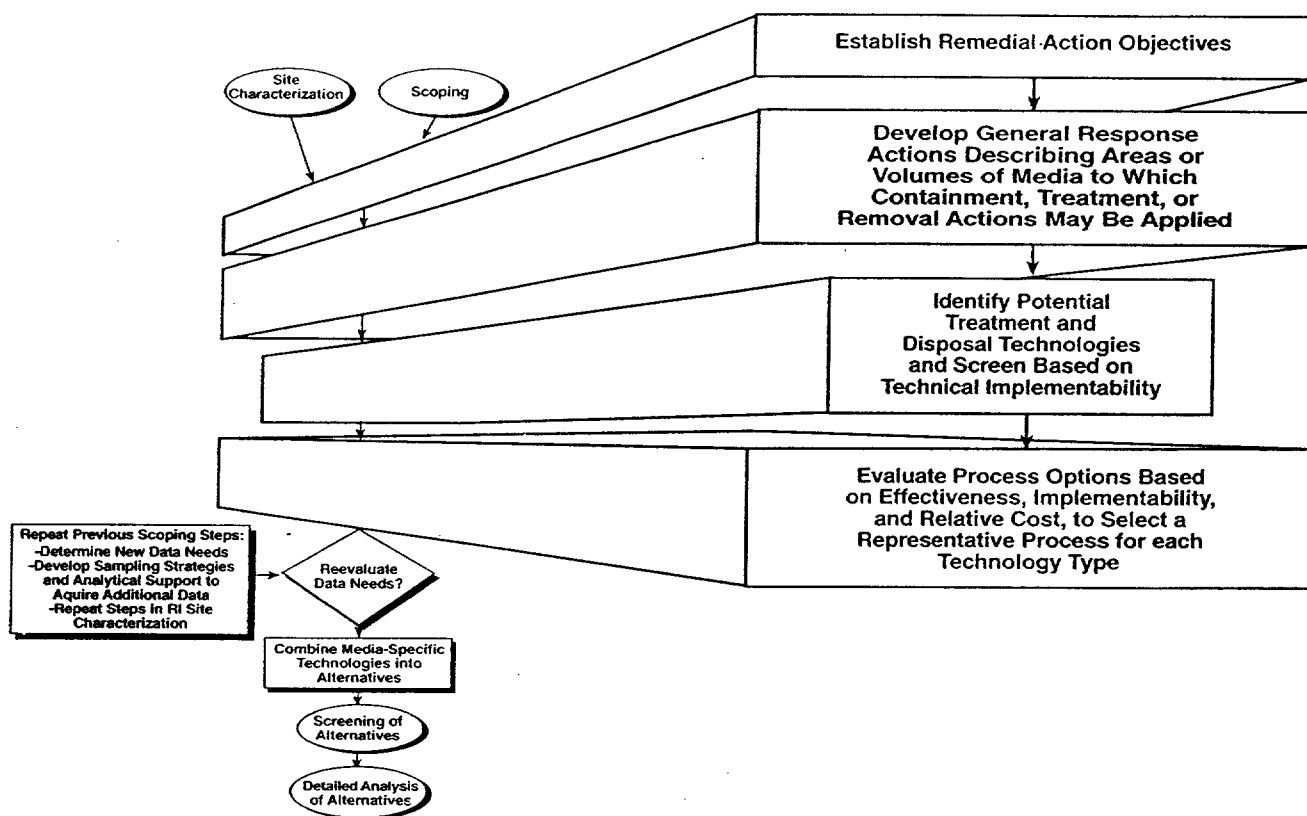
The results of the CMS/FS conducted for the LAOCB/LAACB are summarized in Section VII, and a summary of the comparative analysis of the alternatives is provided in Section VIII.

SB/PP

The culmination of the response action selection process is the Statement of Basis/Proposed Plan (SB/PP). The purpose of the SB/PP is to facilitate public participation in the remedy selection process through the solicitation of public review and comment on all the remedial alternatives described. The SB/PP presents the lead agency's preliminary recommendation (s) concerning how best to undertake a remedial action at a particular waste unit. The SB/PP describes all remedial options that were considered in detail in the CMS/FS, and explicitly identifies the preferred alternative for a remedial action at a waste unit and the preference rationale.

The SB/PP directs the public to the RFI/RI, BRA, and CMS/FS reports as the primary sources of detailed, site specific information, and information on the remedial alternatives analyzed, and provides information on how the public can be involved in the remedy selection process. The public is notified of a public comment period through mailing of the SRS Environmental Bulletin, the Aiken Standard, the Allendale Citizen Leader, the Barnwell People Sentinel, The State, and Augusta Chronicle newspapers, and through announcements on local radio stations. In addition, DOE platforms a public meeting during the public

Figure 7. Response Action Selection Process



Source: EPA, 1988

comment period to receive and discuss questions and comments from the public on the preferred remedial alternative.

ROD

The ROD documents the remedial action plan for a unit and consists of three basic components: a Declaration, the Decision Summary, and the Responsiveness Summary. The purpose of the Declaration is to certify that the remedy selection process was carried out in accordance with the requirements of CERCLA and, to the extent practicable, the NCP. The Decision Summary is a technical and information document that provides the public with a consolidated source of information about the history, characteristics, and risks posed by a unit, followed by a summary/evaluation of the cleanup alternatives considered that led to the selected remedy. The Responsiveness Summary presents comments received during the public comment period (April 4 through May 18, 1997) on the SB/PP, and a response to each comment or criticism, submitted in writing or orally. The Responsiveness Summary for the LAOCB/LAACB is provided in Appendix A and an explanation of significant changes resulting from public comment is provided in Section XI.

SRS received a hazardous waste permit from the South Carolina Department of Health and Environmental Control (SCDHEC) which is renewed every five (5) years. The permit was most recently renewed on September 5, 1995. Part IV of the permit mandates that SRS establish and implement an RFI Program to fulfill the requirements specified in Section 3004(u) of the Federal permit. The LAOCB and LAACB are Solid Waste Management Units (SWMUs) listed on the SRS RCRA Permit because the units received hazardous substances. Thus, the remedial decision for these SWMUs requires a RCRA Permit Modification. Specific comments and responses received during the April 4, 1997 - May 18, 1997 public comment period on the proposed remedial action and the associated draft RCRA permit modification are included in the Responsiveness Summary of this ROD (Appendix A) and with the final RCRA Permit. The final RCRA Permit and the ROD document the final decision for this operable unit.

Post-ROD Documentation

The post-ROD documentation consists primarily of the design documents that are required prior to initiating a remedial action. Specific post-ROD documents include, the corrective measure/remedial design workplan, the corrective measure/remedial design report, the corrective measure/remedial action workplan,

and the post-construction report. A discussion of the schedules that apply to these documents is provided in the SB/PP and Section XIII of this ROD.

Southern L-Area Remedial Strategy

The RFI/RI process provides a method of managing the steps to ultimate remediation of a specific waste unit. It is often preferable to group waste unit components and actions to expedite characterization and remediation of the components that pose the most significant risks. These groupings are typically designated as OUs. A "source control OU" may consist of a number of potential sources of contamination, and usually indicates that there is a preference toward collective characterization and ultimate remediation of these sources. A "groundwater OU" usually consists of a specific area of groundwater contamination and proposed actions related to its characterization and ultimate remediation, and/or the timing of these actions.

The LAOCB and LAACB have been grouped into a source control OU that is located within the Steel Creek Watershed (Figure 8). Several source control and groundwater OUs within this watershed will be evaluated to determine future impacts, if any, to associated streams and wetlands. It is the intent of SRS, EPA, and the SCDHEC to manage these sources of contamination to minimize impact to the watershed. To effectively manage the impact to the Steel Creek Watershed (groundwater, streams, and wetlands), a comprehensive characterization and regulatory process plan for the waste units in the vicinity of the LAOCB/LAACB OU was developed. This characterization and regulatory process plan provides a programmatic method of promoting continuous characterization, risk assessment, remedial assessment, and remedial action.

The waste units included in the remedial process plan consist of the LAOCB/LAACB OU, the L-Area Hot Shop, and the L-Reactor Seepage Basin. The LAOCB and L-Area Hot Shop received mixed radioactive and hazardous waste, the L-Reactor Seepage Basin received radioactive waste, and the LAACB received characteristic hazardous waste. Because the waste units are located in close proximity and have known and probable groundwater contamination, they represent a complex characterization, remediation and regulatory challenge. The plan consists of a phased approach for the characterization, documentation, and remediation of these waste units. The location of these waste units and overall components of the comprehensive plan are described in Appendix A of the RFI/RI Report (WSRC, 1996a).

During the characterization process of the LAOCB/LAACB OU, it was recognized that the highest concentrations of contaminants and the contaminants with the highest potential risk were primarily

restricted to surficial soils, subsurface soils, and surface water within the LAOCB. In addition, it was recognized that the LAOCB represents a significant source of contamination to unit groundwater. The characterization of the LAOCB/LAACB OU and its associated RFI/RI and BRA documentation provide sufficient information to move forward with a remedial action of this source control OU. Therefore, the CMS/FS, SB/PP, and this ROD are focused on this source control OU.

Groundwater contamination associated with the LAOCB was found to consist primarily of tritium and solvents. However, it was recognized that the extent of the groundwater contamination had not been completely characterized during the RFI/RI. In addition, groundwater contamination is also likely associated with the L-Area Hot Shop and the L-Area Reactor Seepage Basin. Groundwater contamination associated with the Hot Shop is not documented, but soil gas data suggest that chlorinated organic solvents have been released to the soil in the area and may have impacted the local groundwater. Groundwater contamination associated with the L-Area Reactor Seepage Basin is known to consist of tritium (historical groundwater monitoring).

A comprehensive groundwater OU was created as the L-Area Southern Groundwater OU because of the uncertainty associated with the nature and extent of the known and suspected groundwater plumes in the vicinity of the LAOCB/LAACB OU, L-Area Hot Shop, and L-Area Reactor Seepage Basin. Because any remedial actions directed toward the groundwater could cause further commingling of contaminant plumes, a phased remedial investigation of the groundwater plumes will be conducted as part of the integrator OU strategy. The phased process would continue until all the components of the source control, vadose zone, and groundwater OUs are characterized and documented.

v. OPERABLE UNIT CHARACTERISTICS

CSMs were developed for the LAOCB and LAACB that identify the primary sources, primary contaminated media, migration pathways, exposure pathways, and potential receptors for each unit. The CSMs for the LAOCB and LAACB are presented in Figures 9 and 10, respectively, and are based on the data that are presented in the RCRA/CERCLA documentation for these units. The Data Summary Report (WSRC, 1995b), RFI/RI Report (WSRC, 1996a), and Baseline Risk Assessment (WSRC, 1996b) contain detailed analytical data for all of the environmental media samples taken in the characterization of the LAOCB/LAACB. These documents are available in the Administrative Record (See Section III).

As previously stated in Section IV, it has been recognized that the highest potential risk is primarily restricted to soil and surface water within the LAOCB. In addition, the extent of the groundwater

Figure 9. Conceptual Site Model for the LAOCB

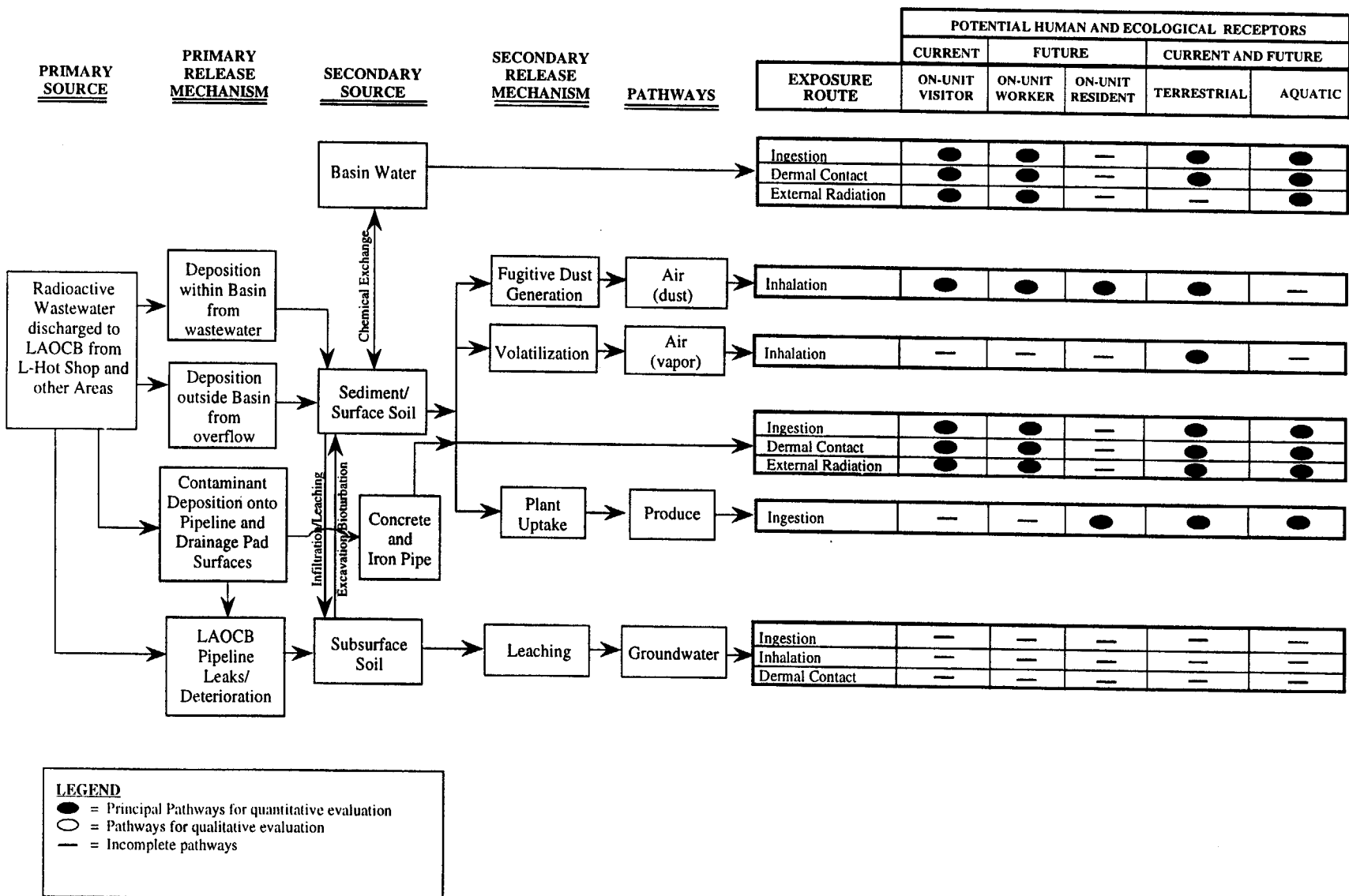
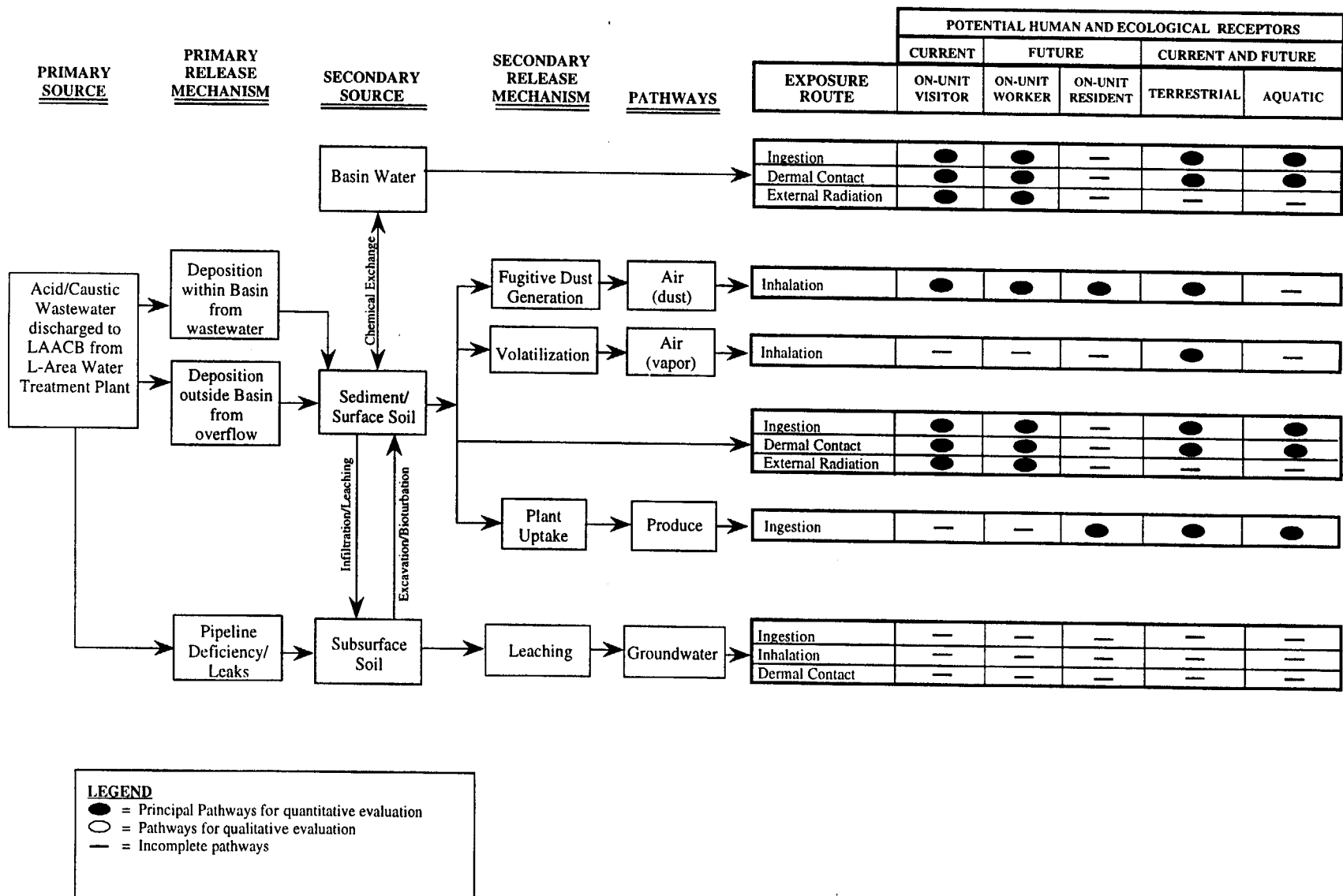


Figure 10. Conceptual Site Model for the LAACB



contamination has not been completely characterized during the RFI/RI, and further investigation is necessary to proceed with a risk assessment and CMS/FS for unit groundwater. Therefore, the following discussion of the OU will be focused on the primary and secondary sources of the LAOCB and LAACB, and will not include a description of the characteristics of the unit groundwater.

L-Area Oil & Chemical Basin

LAOCB Primary Sources and Release Mechanisms

The primary sources were radioactive wastewater discharged to the LAOCB from the Hot Shop via the LAOCB pipelines and other SRS areas via the concrete drainage pad (see Figure 9). Residual wastewater is no longer present in the LAOCB, and its presence in the pipelines is unlikely because all piping was constructed as gravity feed, and no wastewater has been discharged through the piping for approximately 30 years. Radioactive contamination on the internal surfaces of the LAOCB pipelines is documented [approximately 300,000 disintegrations per minute (dpm) as measured at the discharge end in the LAOCB], and there is a high probability of radioactive contamination of the concrete drainage pad and associated piping based on process knowledge.

The primary release mechanisms are deposition inside the basin, deposition outside the basin from overflow, deposition onto the pipeline and drainage pad surfaces, and leakage of the pipelines (see Figure 9). The most significant of these release mechanisms are the release of unit contaminants to the surface soil in the basin bottom and pipeline leaks to the subsurface soils along the LAOCB pipelines. In addition, there are no documented occurrences of basin overflow, and surface radiation surveys indicate the basin did not overflow.

LAOCB Secondary Sources and Release Mechanisms

Secondary sources include sludge/organic sediment and subsurface soil in the LAOCB, surface water in the basin that accumulates from precipitation, surface and subsurface soil around the basin, concrete and steel pipe, and subsurface soil along the pipeline (see Figure 9). A detailed sampling and analysis plan was prepared and implemented to investigate these secondary sources and a complete description of the sampling methods and protocols are provided in the RFI/RI Report (WSRC, 1996a).

Sludge/organic sediment and subsurface soil were collected from five locations within the LAOCB (see Figure 3) using a remote vibracore sampling device to reduce cross contamination of samples and

minimize worker exposure. The sampling of the basin sludge indicates that the sludge is approximately six inches thick. Based on the analysis of samples collected from the five locations within the basin, the sludge and organic sediment within the LAOCB is highly contaminated with radionuclides. Twenty-four radionuclides and gross alpha and non-volatile beta were detected above screening levels in the LAOCB sludge (Table 1). The major man-made radionuclides with respect to activity within the basin sludge are: americium-241 (^{241}Am), ^{137}Cs , cobalt-60 (^{60}Co), curium-244 (^{244}Cm), europium-152 (^{152}Eu), ^{154}Eu , ^{155}Eu , promethium-147 (^{147}Pm), ^{238}Pu , ^{239}Pu , ^{90}Sr , uranium-234 (^{234}U), ^{235}U , ^{238}U , and ^3H . A review of the data also indicates the primary fission products are ^{137}Cs , ^{90}Sr , ^{152}Eu , ^{154}Eu , and ^{155}Eu , the primary activation product is ^{60}Co , and the primary alpha-emitters are ^{238}Pu , ^{239}Pu , and ^{238}U . In addition, the data indicate that tritium contributes at least one third of total activity within the basin sludge with a maximum of 15,498 pCi/g. The subsurface soil underlying the basin sludge is also highly contaminated with radionuclides as described for the sludge. The average activity for the basin sludge and subsoils (to a depth of 1.5 ft) is 3833.3 pCi/g for the major radionuclides (i.e., ^{241}Am , ^{137}Cs , ^{60}Co , ^{152}Eu , ^{154}Eu , ^{155}Eu , ^{238}Pu , ^{239}Pu , ^{90}Sr , ^{235}U , ^{238}U , and ^3H). Based on the activities of the soil samples collected during this investigation, the total radionuclide activity within the basin (including the sludge and subsoils to a depth of 1.5 ft) is estimated at approximately 4.2 Ci.

The concentrations of radionuclides in the LAOCB subsoils tend to decrease rapidly with depth. An analysis of the attenuation of the maximum gross alpha and non-volatile beta activities indicates that radionuclide concentrations (other than ^3H) should reach background activity levels within approximately two feet from the top of the sludge. Linear regression of the gross alpha values (log) versus sample depth demonstrates that the maximum observed gross alpha values will decrease to activities less than detectable levels at a depth of approximately 1.5 ft from the top of the sludge (Figure 11). Linear regression of the gross non-volatile beta values (log) versus sample depth demonstrates that the maximum observed gross non-volatile beta values will decrease to activities less than detectable levels at a depth of approximately 2.0 ft from the top of the sludge (Figure 11). The radionuclide concentrations are highly correlative (as expected) with the gross alpha and gross non-volatile beta values for the samples. Because the rapid reduction of activities is logarithmically correlated with depth, any intervals deeper than 1.25 ft would represent additional activities of only a fraction of one percent. A review of the ^3H activities of the basin sludge and subsoils indicates that ^3H activities also decrease rapidly with depth. As previously stated, the maximum ^3H activity within the basin sludge is 15,498 pCi/g, however, the maximum ^3H activity at one foot below the basin sludge is 137.9 pCi/g. A comparison of ^3H ratios to the major radionuclides within the basin suggests that the ^3H has reached equilibrium conditions with respect to depth.

Table 1
Summary of Detected Radionuclides
LAOCB Soil and Sediment

Analyte	2 X Average Background Value	Frequency of Detects Above 2 X Average Background	Highest Detection
RADIOISOTOPES (pCi/g)			
Actinium-228	1.25	9/12	11.86
Americium-241	1.25	9/12	804.65
Antimony-125	0.34	12/12	7.44
Bismuth-214	0.91	9/12	9.30
Cerium-144	0.91	8/12	6.98
Cesium-134	0.11	12/12	2.09
Cesium-137	0.11	12/12	1154.20
Cobalt-60	0.11	12/12	5241.80
Curium-244	---	+ 12/12	339.72
Europium-152	0.34	12/12	297.67
Europium-154	0.34	12/12	109.30
Europium-155	0.57	8/12	4.88
Lead-212	---	+ 12/12	2.79
Lead-214	0.84	6/12	4.75
Plutonium-238	---	+ 10/10	60.15
Plutonium-239	---	+ 10/10	236.51
Potassium-40	1.59	6/12	15.81
Promethium-147	---	+ 9/9	93.98
Strontium-90	---	+ 11/11	2706.60
Thallium-208	1.14	5/12	18.60
Tritium	---	+ 11/11	15498.27
Thorium-234	---	+ 12/12	713.56
Uranium-234	---	+ 10/10	2019.90
Uranium-235	---	+ 12/12	44.07
Uranium-238	---	+ 12/12	2203.30
Gross Alpha	² 20	10/12	13098.60
Non-Volatile Beta	² 50	12/12	22625.90

Legend:

Frequency: 5/12 = Detects above 2 X average background values/total number of samples analyzed.

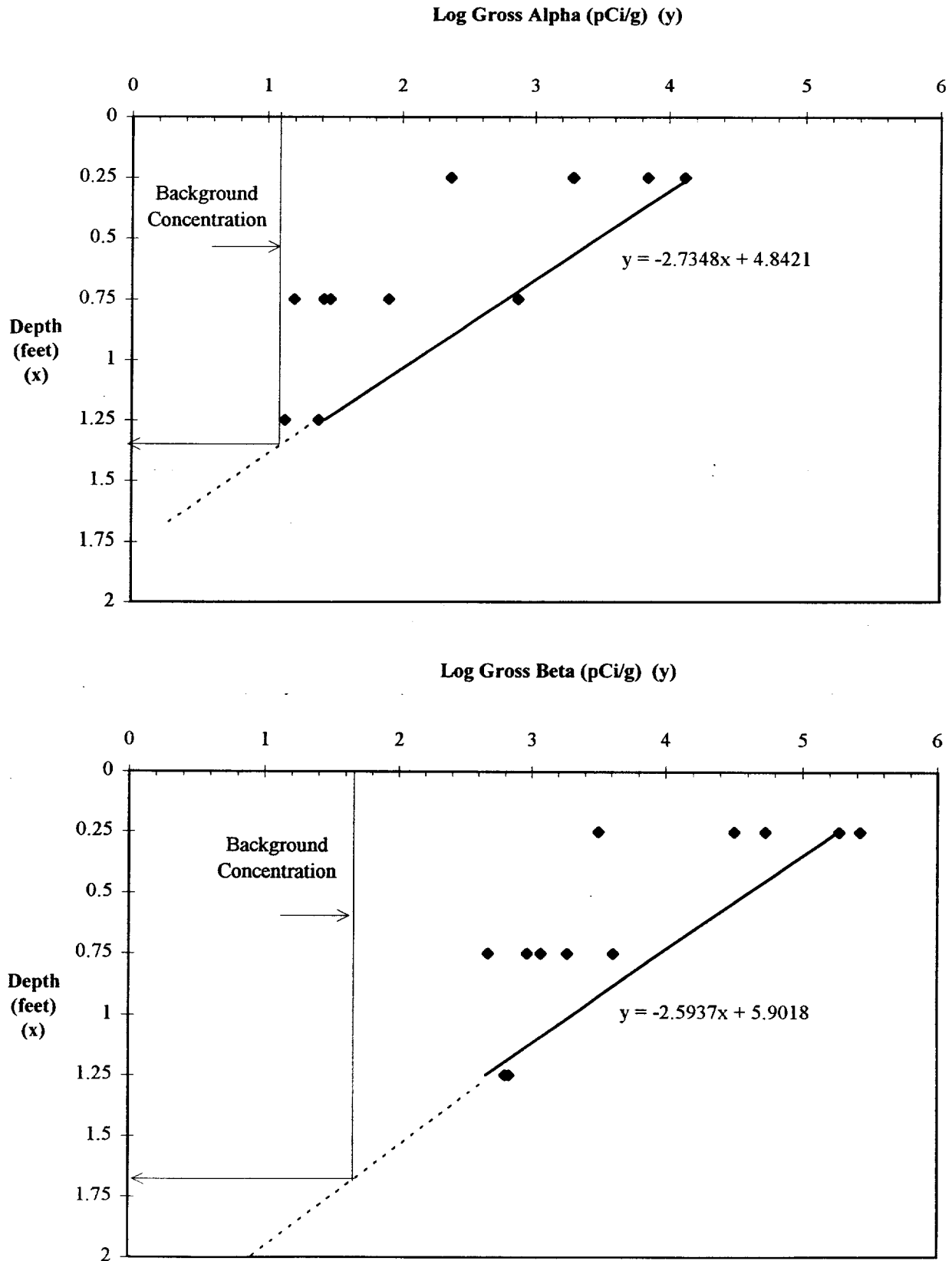
+ No site-specific background value exists for analyte. Frequency reported is detects/total number of samples analyzed.

--- No value available.

RBCs - EPA Risk Based Concentrations (1E-06)

² The screening levels of 20 and 50 pCi/g for gross alpha and non-volatile beta, respectively, are based on site-specific background samples and the presence of naturally occurring radionuclides

Figure 11. Gross Alpha and Non-Volatile Beta Concentrations vs. Depth



The rapid decrease in contaminant concentrations with relatively shallow depth is due principally to the presence of dense, kaolinitic clay and iron oxide cemented sediments that underlie the basin and the surrounding area. This stratigraphic horizon (which is correlatable in the vicinity of the unit) is termed the "hardpan" and is described in detail in the RFI/RI Report (WSRC, 1996a). Figure 12 illustrates the location of the hardpan relative to the basin and other strata in the vicinity. The moisture content and hydraulic conductivity of the hardpan beneath the basin appear to be low enough to significantly retard migration of radionuclides and other contaminants. The sampling of the subsoils below the basin indicates that the free moisture content of these soils is very low (visual examination suggested that the free moisture content was probably less than 5 percent). The basin contained approximately 1.5 ft of standing water at the time of sampling. The moisture content of the subsoils below the sludge versus the hydraulic conditions of the basin suggests that the hydraulic conductivity of the subsoils/hardpan is very low.

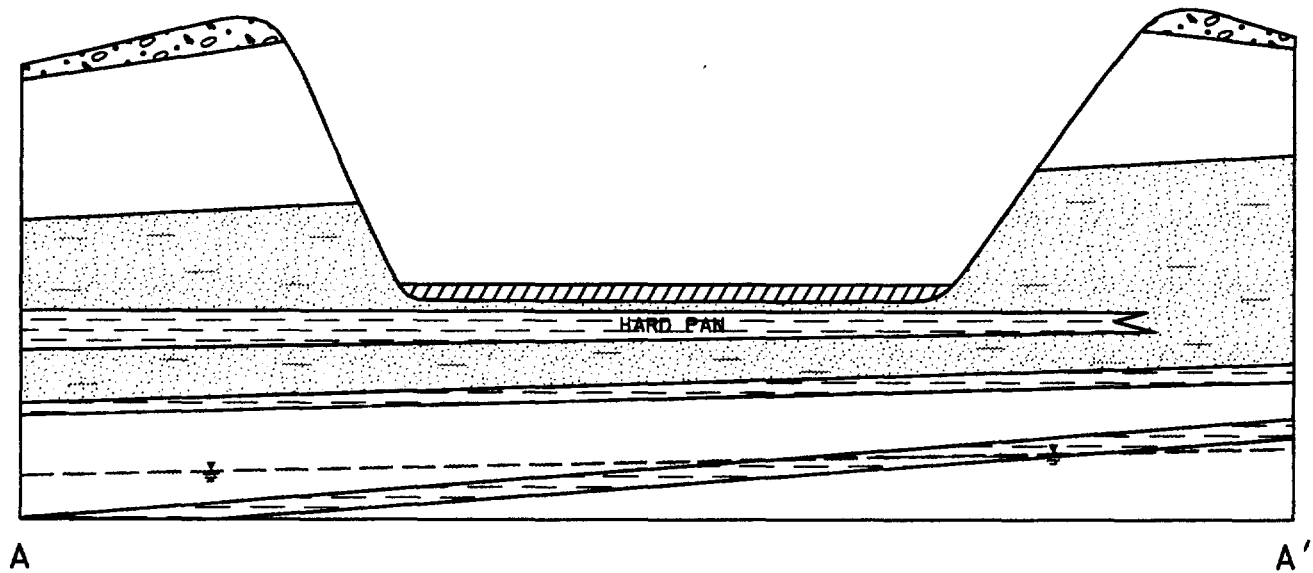
Four volatile organic compounds (VOCs) were detected in the LAOCB sludge and subsoil at concentrations exceeding screening levels. All VOCs but methyl ethyl ketone (MEK) were determined to be false positives. Reported MEK concentrations are near the screening level and well below risk based concentrations (RBCs). The LAOCB sludge contains petroleum hydrocarbons with a median observed concentration of 11.34 mg/kg, and a maximum observed concentration of 7186 mg/kg.

Seventeen metals were detected in the LAOCB sludge and subsoil at concentrations exceeding screening levels. Relatively high concentrations of Cr, Be, Cu, Cd, Pb, and Zn are attributed to decontamination of stainless steel, galvanized metals, and brass. All 17 metals, except Ba, Co, Cu, Hg, and Zn, exceed RBCs in at least one sample.

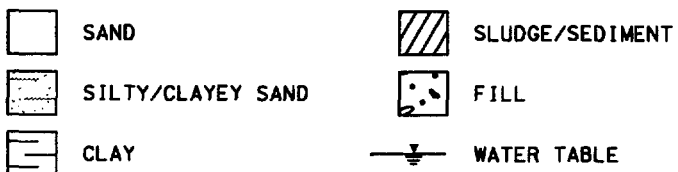
Surface water was collected from two locations in the basin (see Figure 3). Seven radionuclides were reported in the LAOCB surface water. ^{137}Cs , ^{60}Co , and ^{90}Sr were detected at concentrations exceeding RBCs and are believed to originate from the LAOCB sludge/organic sediment. ^3H activity in the surface water is very low considering the ^3H activity in the sludge. Reported concentrations of ^{214}Bi , ^{208}Tl , and ^{40}K in the surface water are probably of natural origin. Based on the 1994 sampling and analysis results, there are no significant concentrations of VOCs present in the surface water in the LAOCB. Nine metals are reported for the surface water samples collected within the LAOCB, of which only Mn is reported at concentrations exceeding screening limits. No screening limits are available for Ca, Fe, or K.

Vegetation samples were collected from within the LAOCB security fence to determine the potential uptake of unit contaminants. For comparative purposes, samples of similar vegetation were also collected from an unimpacted background reference location. Seven radionuclides were detected in the samples

Figure 12. Cross-Section of LAOCB and Surrounding Soils



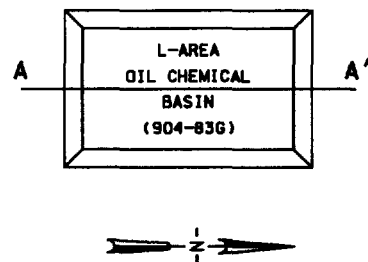
LEGEND



SCALE

HORIZONTAL: 1 IN = 40 FT
VERTICAL: 1 IN = 10 FT

INDEX MAP



analyzed. Mean ^{137}Cs concentrations are significantly higher at the LAOCB than at the reference area for similar vegetation types with the highest concentrations detected in vegetation collected nearest the water (black willow, rush, and sedge). In addition, mean concentrations in vegetation are much higher than the mean concentration of ^{137}Cs in SRS soils (0.15 pCi/g) estimated by Fay and Pickett (1987). Elevated levels of ^{137}Cs detected in the vegetation at the LAOCB are unit-related. Mean ^{60}Co concentrations in vegetation at the LAOCB are higher than the trace levels which normally occur in plants and are also likely to be unit-related. Sixteen metals are reported in the vegetation samples collected in the LAOCB. All detected metal concentrations from samples collected from the LAOCB are either at or below those observed in the reference area, are within acceptable background ranges for the SRS, and/or are ecologically insignificant. In conclusion, the vegetation within the LAOCB security fence is contaminated with radionuclides from the basin. An ecological risk assessment was performed for selected media within the LAOCB security fence and the results are discussed in Section VI.

There is no man-made radionuclide contamination of soils outside and adjacent to the LAOCB security fence. The detected radionuclides are determined to be strictly naturally occurring. Six VOCs and one semi-volatile organic compound (SVOC) are reported at concentrations exceeding screening limits in soil samples from locations adjacent to the LAOCB. However, most detections are determined to be suspect with respect to laboratory data quality, and do not exhibit any apparent trends in vertical or lateral distribution. Eighteen metals are reported in the soil samples collected adjacent to the LAOCB. Cr, V, Al, As, and Fe were the only metals reported above screening limits with more than 25 percent frequency. The reported metals were determined to be naturally occurring and not a result of unit operations. No pesticides, polychlorinated biphenols (PCBs), dioxins, or furans are reported in any of the soil samples collected adjacent to the LAOCB.

Soil samples were collected at nine locations along the LAOCB pipelines (see Figure 3). Samples were collected to a maximum depth of approximately 10 feet below land surface along the pipelines to evaluate potential leaks which may have occurred during operation. The analytical results indicated elevated concentrations of naturally occurring radionuclides (e.g., ^{40}K and ^{208}Tl) and metals (e.g., Be and Tl), and constituents resulting from farming activities prior to SRS (i.e., As). However, no man-made radionuclide contamination of soils along the LAOCB pipeline was detected. Several VOCs were detected at concentrations exceeding screening levels, however, all but MEK were determined to be laboratory artifacts. No SVOCs are reported at concentrations exceeding screening levels, and no pesticides or PCBs are reported in any of the soil samples collected along the LAOCB pipeline. Metal concentrations reported for samples collected along the LAOCB pipeline are consistent with those reported for the soils adjacent to the LAOCB described above. Although the analytical results do not indicate significant impact to

subsurface soils along the LAOCB pipelines, it is anticipated that residual radionuclides, organics, and metals from leaks in the pipeline may be present in the subsurface soils that were not encountered during the RFI/RI sampling activities.

Secondary release mechanisms associated with these sources include volatilization from soil and basin water, fugitive dust generation from exposed surface soil, biotic uptake, and leaching to groundwater. The most significant of these secondary release mechanisms are the current release of unit contaminants to the air through fugitive dust generation and leaching to unit groundwater. The quantified risks associated with these and other exposure routes are summarized in Section VI.

Summary of LAOCB Primary and Secondary Sources

The characterization of the primary and secondary sources associated with the LAOCB indicates that soil in the LAOCB is highly contaminated with radionuclides. The concentrations of the radionuclides in the LAOCB sediment tend to decrease rapidly with depth, and generally reach background levels within approximately two feet from the top of the sediment in the basin. Seven of the radionuclides detected in the LAOCB soil are also detected above screening levels in the basin surface water. The man-made radionuclides detected in soils at the site are restricted to the LAOCB and are attributed directly to unit operations. Metals concentrations in the LAOCB soil are generally above screening limits and are relatively high, when compared to the LAACB soil and soils from the remainder of the OU. The occurrence of several of the metals detected above screening levels are attributed to unit operations. Petroleum hydrocarbons are present in high concentrations in the LAOCB soil and are attributed to unit operations. Ecological sampling of the basin indicated that ^{137}Cs and ^{60}Co were the principal radionuclides detected in vegetation samples from the LAOCB. These radionuclides have the potential to pose risk to ecological receptors exposed to contaminated media directly or through the food chain, such as animals which consume either contaminated vegetation or other animals with bioaccumulated residues of these radionuclides in their tissues. Based on these data, it is apparent that the media inside the LAOCB have been significantly impacted by unit operations, and a remedial action is appropriate.

The results of the soil investigation along the LAOCB pipelines indicate that these soils have not been impacted by unit operations, however, radioactive contamination of the internal surface of the LAOCB pipelines has been documented to be approximately 300,000 dpm. The pipelines are relatively shallow (buried less than four feet below land surface) and exposed at one point in a drainage ditch near the Hot Shop. Both pipelines are constructed of iron pipe and are subject to natural corrosion processes. Based upon the known radiological contamination associated with the interior of the LAOCB pipelines, and the

probability the pipe will eventually corrode to the point of allowing the release of fixed/transferrable contamination to the environment, a remedial action to eliminate the potential release of radioactive contamination from the pipelines is appropriate. In addition, since the concrete drainage pad and associated piping of the staging area on the north end of the LAOCB are likely contaminated with fixed and/or transferable radioactive contamination, these components should be remediated at the same time as the basin remediation.

L-Area Acid/Caustic Basin

LAACB Primary Sources and Release Mechanisms

Acid/caustic wastewater discharged from the L-Area water treatment plant via the LAACB pipeline was the primary source. Residual wastewater is no longer present in the LAACB, and its presence in the pipeline is unlikely because all piping was constructed as gravity feed, and no wastewater has been discharged through the piping for approximately 30 years.

The primary release mechanisms associated with these sources are deposition inside the basin, deposition outside the basin from overflow, infiltration and percolation, and leakage of the pipeline (see Figure 10). The most significant of these release mechanisms are the release of unit contaminants to surface soil inside the basin and from the leakage of wastewater from the pipeline to the subsurface soil along the LAACB pipeline.

LAACB Secondary Sources and Release Mechanisms

Secondary sources include organic sediment and subsurface soil in the LAACB, surface water in the basin that occasionally accumulates from precipitation, and surface and subsurface soil around the basin and in the effluent ditch south of the basin. Subsurface soil is the only secondary source associated with the LAACB pipeline since it is buried approximately six feet below land surface. A detailed sampling and analysis plan was prepared and implemented to investigate these secondary sources and a complete description of the sampling methods and protocol are provided in the RFI/RI Report (WSRC, 1996a). No surface water was present in the LAACB during the RFI/RI, and consequently, no analytical results are available.

Organic sediment and surface/subsurface soil were collected from two locations within the LAACB (see Figure 3). Radionuclides, VOCs, and SVOCs were not reported above screening values in the LAACB

sediment and subsurface soil. Some LAACB sediment samples were reported with oil and grease. Petroleum hydrocarbons were reported in low concentrations in one sample. Sodium concentrations exceed screening limits in 90 percent of the samples analyzed and are attributed to the discharge of caustic soda (NaOH) solutions to the basin. In addition, reported pH measurements are alkaline (11.24 to 11.50) as would be expected for soils in contact with caustic solutions.

Surface and subsurface soil were collected from four locations adjacent to the LAACB (see Figure 3). Radionuclide analyses of these samples did not indicate the presence of man-made radionuclides. Based on these results, there is no radionuclide contamination of soils adjacent to the LAACB. Acetone and carbon disulfide were the only VOCs reported at concentrations exceeding screening values. However, all occurrences of these two VOCs were determined to be laboratory artifacts. Bis(2-ethylhexyl)phthalate was the only SVOC detected above screening limits. All detections were near the detection limit and exhibit no apparent trends in distribution. No pesticide/PCBs are reported above screening limits in soils adjacent to the LAACB. No furans and no significant dioxin contamination were reported for soil samples. Based on these results, there is no organic compound contamination of soils adjacent to the LAACB. Zn, Sb, As, Pb, Mn, K, and V were the only metals reported at concentrations above screening limits, with Zn being the only metal reported to exceed screening levels in more than 25 percent of samples analyzed. The occurrence of metals is consistent with metals detected in the soils adjacent the LAOCB and LAOCB pipeline, and their presence is not attributed to unit operations. Soil pH measurements generally range from 5.73 to 7.29 (typical for SRS soils). Lower pH values (2.01 to 2.12) were reported for soils on the east side of the basin, however, follow-up sampling indicated that these low values were due to analytical error and there is no unit impact to soils on the east side of the basin.

Sixteen metals were detected in the vegetation samples collected in the LAACB. Of the 16 metals that were analyzed and detected at the basin and that have a significant potential for toxicity, only Cd levels may be unit-related and elevated above reference levels. Cd concentrations in soils of the LAACB are not elevated with respect to unit specific soil background. The presence of Cd in unit vegetation at concentrations above the reference area vegetation concentrations may be a function of soil differences between the waste unit and the reference area or the natural range of Cd in vegetation, and not due to unit specific contamination. In addition, if the Cd present in vegetation at the unit was unit related, the ecological impact of this vegetation would be very low because the vegetation of the unit would represent a very small percentage of the diet of any potential ecological receptors, and the intake of Cd by any potential ecological receptors would be negligible. All other detected metal concentrations from vegetation samples collected from the LAACB are either at or below those observed in the reference area, within acceptable background ranges for SRS, and/or ecologically insignificant.

No radionuclide, VOC, or SVOC contamination is indicated in soils along the LAACB pipeline and effluent drainage ditch. PCB-1254 and octachlorodibenzo p-dioxin isomers were reported at very low concentrations and are considered insignificant. Nineteen metals were reported above screening levels along the pipeline and drainage ditch. Cr, Pb, Se, Mn, V, and Zn are the only metals detected above screening limits in more than 35 percent of samples analyzed. With the exception of Pb, Mn, and V, all reported concentrations of the metals are below RBCs. LAACB pipeline and drainage ditch soil sample pH measurements typically range from 5 to 7.

Secondary release mechanisms associated with these sources include volatilization from soil and basin water, fugitive dust generation from exposed surface soil, biotic uptake, and leaching to groundwater. The most significant of these secondary release mechanisms are the current release of unit contaminants to the air through fugitive dust generation and leaching to unit groundwater. The quantified risks associated with these and other exposure routes are summarized in Section VI.

Summary of LAACB Primary and Secondary Sources

With the exception of consistently elevated Na concentrations in the LAACB surface/subsurface soil and the elevated Cd levels in LAACB vegetation, the environmental media associated with the LAACB have not been impacted by unit operations. No man-made radionuclides, organic compounds, or metals were consistently identified in unit soils at concentrations above screening levels that would indicate contamination from unit operations.

VI. SUMMARY OF OPERABLE UNIT RISKS

As part of the investigation/assessment process for the LAOCB/LAACB waste unit, a BRA was performed using data generated during the assessment phase. Detailed information regarding the development of COPCs, the fate and transport of contaminants, and the risk assessment can be found in the RFI/RI Report (WSRC, 1996a) and the Baseline Risk Assessment (WSRC, 1996b).

An exposure assessment was performed to provide an indication of the potential exposures which could occur based on the chemical concentrations detected during unit-specific sampling activities. The current land use scenario is an inactive industrial site. The only current exposure scenario identified for the LAOCB/LAACB was for on-unit visitors, who may perform environmental research such as groundwater sampling on a limited and intermittent basis at the LAOCB/LAACB. Conservative future exposure

scenarios identified for the LAOCB/LAACB included future on-unit industrial workers and future on-unit resident adults and children. The future residential scenario includes homegrown produce as an exposure point, which is not considered under the current on-unit visitor or future industrial worker scenarios. Risks and hazards from exposures under the three land use scenarios at LAACB and LAOCB are presented in Tables 2 and 3, respectively. The unit-specific risks for the LAACB and LAOCB are further explained below.

L-Area Acid/Caustic Basin

The media evaluated in the BRA include soil inside the LAACB, soil adjacent to the LAACB, soil along the LAACB pipeline, and soil along the LAACB overflow drainage ditch. The BRA concluded that the LAACB, adjacent area, overflow drainage ditch, and associated pipeline represent low to non-existent risk (less than 1×10^{-6} and HIs less than 1.0) under the current and future on-unit worker scenarios. For the future on-unit resident, all estimated nonradiological cancer risks were less than 1×10^{-6} except for two pathways, ingestion of soils 0-2 ft adjacent to the LAACB and ingestion of soils 0-4 ft at the LAACB pipeline. These risks are very low (approximately 3×10^{-6}), and are attributed solely to arsenic and one dioxin that are not unit related. Therefore, a No Action alternative is proposed for the LAACB. The No Action alternative will be protective of human health and the environment.

The LAACB will be backfilled with native soil and vegetation will be established in a similar fashion to the clean closure of the F-, H-, K-, and P-Acid/Caustic Basins (WSRC, 1995a). Final grade will be sloped to promote drainage and conform with surrounding terrain. The No Action alternative will be protective of human health and the environment, and no post ROD documentation or reviews will be necessary.

L-Area Oil & Chemical Basin

The media evaluated in the BRA include soil inside the LAOCB, surface water inside the LAOCB, and soil adjacent to the LAOCB. Exposure to basin soils represents the greatest risk at the LAOCB. Direct radiation exposure is the primary risk pathway. The primary contributors to this risk are ^{60}Co and ^{137}Cs . Results of the BRA are summarized below.

Table 2. Summary of Operable Unit Risks - LAACB

Table 2. Current and Future On-Unit Risks - LAACB

LAACB Exposure Point Exposure Route	Nonradiological Current On-Unit Visitor Risk	Nonradiological Risk Drivers	Nonradiological Current On-Unit Visitor Hazard	Nonradiological Hazard Drivers
Soil (0-4 ft inside LAACB) dermal ingestion inhalation	NA NA NA		NA NA NA	
Soil (0-2 ft outside LAACB) dermal ingestion inhalation	2.4E-10 1.0E-9 1.2E-10	OCDD 95%, As 5% As 88%, OCDD 12% As 100%	3.9E-5 2.8E-4 3.8E-5	OCDD 56%, Pb 22%, Sb 10% Pb 47%, Sb 22%, Tl 17% Mn 98%, Pb 2%
Soil (0-4 ft LAACB Pipeline) dermal ingestion inhalation	NA NA NA		NA NA NA	
Soil (0-12 ft LAACB Pipeline) dermal ingestion inhalation	NA NA NA		NA NA NA	

Soil was the only media with exposure pathways which were quantified.

NA - Not applicable for this receptor.

NC - Could not quantify due to limited toxicity information.

Values for inhalation of dust and volatiles in air are estimated from COPC concentrations in soil.

Table 2. (continued) Summary of Operable Unit Risks - LAACB

Table 2. (continued) Current and Future On-Unit Risks - LAACB

LAACB Exposure Point Exposure Route	Nonradiological Future On-Unit Worker Risk	Nonradiological Risk Drivers	Nonradiological Future On-Unit Worker Hazard	Nonradiological Hazard Drivers
Soil (0-4 ft inside LAACB) dermal ingestion inhalation	NA NC NA		NA 2.0E-2 7.2E-5	Pb 100% Pb 100%
Soil (0-2 ft outside LAACB) dermal ingestion inhalation	NA 3.2E-7 3.8E-8	As 88%, OCDD 12% As 100%	NA 1.8E-2 2.4E-3	Pb 47%, Sb 22%, Tl 17%, As 8% Mn 98%, Pb 2%
Soil (0-4 ft LAACB Pipeline) dermal ingestion inhalation	NA 3.4E-7 5.1E-8	As 100% As 100%	NA 1.5E-2 1.5E-3	Pb 61%, Sb 25%, As 12% Mn 97%, Pb 3%
Soil (0-12 ft LAACB Pipeline) dermal ingestion inhalation	NA 7.9E-8 4.2E-10	OCDD 100% OCDD 100%	NA 1.5E-2 1.5E-3	Pb 39%, Sb 19%, V 17%, Hg 14% Mn 95%, Hg 3%, Pb 2%

Soil was the only media with exposure pathways which were quantified.

NA - Not applicable for this receptor.

NC - Could not quantify due to limited toxicity information.

Values for inhalation of dust and volatiles in air are estimated from COPC concentrations in soil.

Table 2. (continued) Summary of Operable Unit Risks - LAACB

LAACB Exposure Point Exposure Route	Nonradiological Future On-Unit Resident Risk	Nonradiological Risk Drivers	Nonradiological Future On-Unit Resident Hazard		Nonradiological Hazard Drivers
			Adult	Child	
Soil (0-4 ft inside LAACB) dermal ingestion inhalation	NC NC NC		3.6E-3 1.5E-1 1.3E-4	6.9E-3 5E-1 4.2E-4	Pb 100% Pb 100% Pb 100%
Soil (0-2 ft outside LAACB) dermal ingestion inhalation	2.6E-7 2.9E-6 8.5E-8	OCDD 95%, As 5% As 88%, OCDD 12% As 100%	6.9E-3 1.3E-1 4.4E-3	1.3E-2 4.6E-1 1.4E-2	OCDD 56%, Pb 22%, Sb 10% Pb 47%, Sb 22%, Tl 17%, As 8% Mn 98%, Pb 2%
Soil (0-4 ft LAACB Pipeline) dermal ingestion inhalation	1.6E-8 3.0E-6 1.1E-7	As 100% As 100% As 100%	2.5E-3 1.1E-1 2.7E-3	2.7E-3 3.8E-1 8.6E-3	Pb 65%, Sb 26%, Mn 6%, As 3% Pb 61%, Sb 25%, As 12% Mn 97%, Pb 3%
Soil (0-12 ft LAACB Pipeline) dermal ingestion inhalation	4.9E-7 7.0E-7 9.3E-10	OCDD 100% OCDD 100% OCDD 100%	1.0E-2 1.2E-1 2.8E-3	2.0E-2 4.0E-1 8.6E-3	OCDD 73%, Pb 11% Pb 39%, Sb 19%, V 17%, Hg 14% Mn 95%, Hg 3%, Pb 2%
Ingestion of Produce (0-4 ft inside LAACB) leafy tuberous fruit	NC NC NC		3.5E-3 1.2E-2 6.1E-2	5.3E-3 1.8E-2 9.1E-2	Pb 100% Pb 100% Pb 100%
Ingestion of Produce (0-2 ft outside LAACB) leafy tuberous fruit	4.1E-7 3.9E-7 6.9E-7	As 100% As 100% As 100%	1.0E-2 1.9E-2 3.6E-2	1.6E-2 2.9E-2 5.4E-2	Mn 65%, As 17%, Pb 14% Mn 61%, Pb 27%, As 9% Pb 71%, Mn 19%, As 9%

Soil was the only media with exposure pathways which were quantified.

NA - Not applicable for this receptor.

NC - Could not quantify due to limited toxicity information.

Values for inhalation of dust and volatiles in air are estimated from COPC concentrations in soil.

Table 3. Summary of Operable Unit Risks - LAOCB

Table 3. Current and Future On-Unit Risks - LAOCB

LAOCB Exposure Point Exposure Route	Radiological Current On-Unit Visitor Risk	Radiological Risk Drivers
Soil (0-2 ft inside LAOCB) direct external ingestion inhalation	2.7E-6 NA NA	Co-60 91%, Cs-137 5%, Eu-152 3%, Eu-154 1%
Soil (0-2 ft outside LAOCB) direct external ingestion inhalation	NA NA NA	
Soil (0-4 ft LAOCB Pipeline) direct external ingestion inhalation	NA NA NA	
Soil (0-12 ft LAOCB Pipeline) direct external ingestion inhalation	NA NA NA	

LAOCB Exposure Point Exposure Route	Nonradiological Current On-Unit Visitor Risk	Nonradiological Risk Drivers	Nonradiological Current On-Unit Visitor Hazard	Nonradiological Hazard Drivers
Soil (0-2 ft inside LAOCB) dermal ingestion inhalation	NA NA NA		NA NA NA	
Soil (0-2 ft outside LAOCB) dermal ingestion inhalation	3.7E-11 1.7E-9 5.4E-9	As 59%, OCDD 41% As 99%, OCDD 1% CrVI 95%, As 5%	5.6E-5 3.1E-4 3.0E-5	CrVI 72%, Pb 12%, V 6%, Tl 5% Pb 33%, CrVI 20%, V 17%, As 14%, Tl 14% Mn 98%, Pb 2%
Soil (0-4 ft LAOCB Pipeline) dermal ingestion inhalation	NA NA NA		NA NA NA	
Soil (0-12 ft LAOCB Pipeline) dermal ingestion inhalation	NA NA NA		NA NA NA	

Soil was the only media with exposure pathways which were quantified.

NA - Not applicable for this receptor.

NC - Could not quantify due to limited toxicity information.

Values for inhalation of dust and volatiles in air are estimated from COPC concentrations in soil.

Table 3. (continued) Summary of Operable Unit Risks - LAOCB

LAOCB Exposure Point Exposure Route	Radiological Future On-Unit Worker Risk	Radiological Risk Drivers
Soil (0-2 ft inside LAOCB) direct external ingestion inhalation	2.4E-2 1.5E-4 7.8E-6	Co-60 84%, Cs-137 11%, Eu-152 4%, Eu-154 1% Am-241 39%, Sr-90 15%, Pu-239 11%, U-238 9%, Cm-244 7%, U-234 7%, Cs-137 5%, Co-60 5% Tc-99 97%, U-234 1%, U-238 1%
Soil (0-2 ft outside LAOCB) direct external ingestion inhalation	NA NA NA	
Soil (0-4 ft LAOCB Pipeline) direct external ingestion inhalation	NA NA NA	
Soil (0-12 ft LAOCB Pipeline) direct external ingestion inhalation	2.7E-6 8.9E-9 7.8E-6	K-40 77%, Tl-208 23% K-40 100% Tc-99 97%, U-234 1%, U-238 1%

LAOCB Exposure Point Exposure Route	Nonradiological Future On-Unit Worker Risk	Nonradiological Risk Drivers	Nonradiological Future On-Unit Worker Hazard	Nonradiological Hazard Drivers
Soil (0-2 ft inside LAOCB) dermal ingestion inhalation	NA 4.8E-6 1.6E-4	Be 100% CrVI 95%, As 5%	NA 6.6E-1 6.8E-3	CrVI 78%, Pb 17%, Al 2%, Ni 1% Mn 93%, Pb 7%
Soil (0-2 ft outside LAOCB) dermal ingestion inhalation	NA 5.2E-7 1.7E-6	As 99%, OCDD 1% CrVI 95%, As 5%	NA 2.0E-2 1.9E-3	Pb 33%, CrVI 20%, V 17%, As 14%, Tl 14%, Mn 1% Mn 98%, Pb 2%
Soil (0-4 ft LAOCB Pipeline) dermal ingestion inhalation	NA 2.4E-6 1.1E-7	Be 77%, As 23% As 72%, Be 17%, Cd 12%	NA 3.6E-1 2.1E-3	Tl 90%, Pb 6%, Al 2%, As 1% Mn 95%, Pb 5%
Soil (0-12 ft LAOCB Pipeline) dermal ingestion inhalation	NA 1.5E-6 1.2E-7	As 50%, Be 50% As 88%, Be 6%, Cd 5%	NA 1.5E-1 1.3E-3	Tl 82%, Pb 9%, Al 3%, As 3% Mn 95%, Pb 5%

Soil was the only media with exposure pathways which were quantified.

NA - Not applicable for this receptor.

NC - Could not quantify due to limited toxicity information.

Values for inhalation of dust and volatiles in air are estimated from COPC concentrations in soil.

Table 3. (continued) Summary of Operable Unit Risks - LAOCB

Table 3. (continued) Current and Future On-Unit Risks - LAOCB

LAOCB Exposure Point Exposure Route	Radiological Future On-Unit Resident Risk	Radiological Risk Drivers
Soil (0-2 ft inside LAOCB) direct external ingestion inhalation	1.8E-1 6.0E-4 8.9E-6	Co-60 83%, Cs-12%, Eu-152 4%, Eu-154 1% Am-241 40%, Sr-90 14%, Pu-239 11%, U-238 9%, Cm-244 7%, U-234 7%, Cs-137 5%, Co-60 4% Tc-99 97%, U-234 1%, U-238 1%
Soil (0-2 ft outside LAOCB) direct external ingestion inhalation	NA NA NA	
Soil (0-4 ft LAOCB Pipeline) direct external ingestion inhalation	NA NA NA	
Soil (0-12 ft LAOCB Pipeline) direct external ingestion inhalation	2.3E-5 3.6E-8 3.4E-14	K-40 82, Ti-208 18% K-40 100% K-40 100%
Ingestion of Produce (0-2 ft inside LAOCB) leafy tuberous fruit	9.2E-4 2.9E-3 1.5E-3	Sr-90 96%, Cs-137 3%, U-238 1% Sr-90 96%, Cs-137 2%, U-234 1%, U-238 1% Sr-90 69%, Cs-137 30%

Table 3. (continued) Summary of Operable Unit Risks - LAOCB

LAOCB Exposure Point Exposure Route	Nonradiological Future On-Unit Resident Risk	Nonradiological Risk Drivers	Nonradiological Future On-Unit Resident Hazard		Nonradiological Hazard Drivers
			Adult	Child	
Soil (0-2 ft inside LAOCB)					
dermal	1.1E-6	Be 100%	9.7E-1	1.9E+0	CrVI 97%, Pb 2%
ingestion	4.3E-5	Be 100%	4.9E+0	1.7E+1	CrVI 78%, Pb 17%, Al 2%
inhalation	3.6E-4	CrVI 100%	1.3E-2	4E-2	Mn 93%, Pb 7%
Soil (0-2 ft outside LAOCB)					
dermal	4.0E-8	As 59%, OCDD 41%	1.0E-2	1.9E-2	CrVI 72%, Pb 12%, V 6%, TI 5%
ingestion	4.6E-6	As 99%, OCDD 1%	1.5E-1	5.1E-1	Pb 33%, CrVI 20%, V 17%, As 14%, TI 14%, Mn 1%
inhalation	3.8E-6	CrVI 95%, As 5%	3.5E-3	1.1E-2	Mn 98%, Pb 2%
Soil (0-4 ft LAOCB Pipeline)					
dermal	4.4E-7	Be 94%, As 6%	6.5E-2	1.3E-1	TI 90%, Pb 6%, Al 1%, Cd 1%
ingestion	2.2E-5	Be 77%, As 23%	2.7E+0	9.3E+0	TI 90%, Pb 6%, Al 2%, As 1%
inhalation	2.4E-7	As 72%, Be 17%, Cd 12%	3.9E-3	1.2E-2	Mn 95%, Pb 5%
Soil (0-12 ft LAOCB Pipeline)					
dermal	2.1E-7	Be 83%, As 17%	2.6E-2	5.1E-2	TI 84%, Pb 9%, Al 3%, Cd 2%
ingestion	1.4E-5	As 50%, Be 50%	1.1E+0	3.8E+0	TI 82%, Pb 9%, Al 3%, As 3%
inhalation	2.7E-7	As 88%, Be 6%, Cd 5%	2.5E-3	7.7E-3	Mn 95%, Pb 5%
Ingestion of Produce (0-2 ft inside LAOCB)					
leafy	1.8E-6	Be 100%	2.4E-1	3.6E-1	CrVI 50%, Cd 18%, Ni 14%
tuberous	1.7E-6	Be 100%	6.7E-1	1.0E+0	CrVI 66%, Cd 11%, Pb 10%
fruit	3.0E-6	Be 100%	1.4E+0	2.1E+0	CrVI 57%, Pb 26%, Cd 10%
Ingestion of Produce (0-2 ft outside LAOCB)					
leafy	7.5E-7	As 100%	1.0E-2	1.6E-2	Mn 44%, As 32%, Pb 11%
tuberous	7.1E-7	As 100%	1.9E-2	2.8E-2	Mn 42%, Pb 22%, CrVI 18%, As 17%, TI 1%
fruit	1.3E-6	As 100%	3.7E-2	5.5E-2	Pb 55%, CrVI 16%, As 15%, Mn 12%, TI 1%

Soil was the only media with exposure pathways which were quantified.

NA - Not applicable for this receptor.

NC - Could not quantify due to limited toxicity information.

Values for inhalation of dust and volatiles in air are estimated from COPC concentrations in soil.

Current Land Use - Carcinogenic Risks (LAOCB)

Under the current land use scenario, human health risks were characterized for the current on-unit visitor (see Table 2). The highest estimated radiological cancer risk for any pathway was 3×10^{-6} from direct radiation exposure to soils (primarily ^{60}Co) from the LAOCB soil. This risk level is low and within the risk range for NPL sites. All of the estimated nonradiological cancer risks were less than 1.0×10^{-6} .

Current Land Use - Noncarcinogenic Hazards (LAOCB)

Under the current land use scenario, noncarcinogenic hazards were characterized for the current on-unit visitor. The BRA (WSRC, 1996b) shows that potential adverse noncarcinogenic health effects are not likely to occur, because none of the hazard indices exceed a value of 1.0 (see Table 2).

Future Land Use - Carcinogenic Risks (LAOCB)

For the future on-unit worker, cancer risk from radiological constituents exceeded the 1×10^{-6} risk level for soil ingestion and direct radiation. The highest risk was 2×10^{-2} for direct radiation from LAOCB soils due principally to ^{60}Co and ^{137}Cs (see Table 2). Cancer risks for nonradiological carcinogens were all below 1×10^{-6} , except for ingestion and inhalation of the LAOCB soil. The risk from soil ingestion was 4.8×10^{-6} (primarily Be) and the risk from soil inhalation was 1.6×10^{-4} (primarily CrVI).

For the future on-unit resident, cancer risks from radiological exposure exceeded the risk threshold for exposure to LAOCB soils from direct radiation, ingestion, and ingestion of produce grown in LAOCB soils. Risks are estimated at approximately 2×10^{-1} (primarily ^{60}Co and ^{137}Cs) for direct radiation exposure, 5×10^{-3} (primarily ^{90}Sr and ^{137}Cs) for exposure from ingestion of produce grown in LAOCB soils, and 6×10^{-4} (primarily ^{241}Am , ^{90}Sr , and ^{239}Pu) for exposure from LAOCB soil ingestion. Cancer risks for nonradiological carcinogens exceeded 1×10^{-6} . The risk of 4×10^{-4} from inhalation of LAOCB soils is due primarily to CrVI, the risk of 4.3×10^{-5} from ingestion of LAOCB soils is due to Be, and the risk of 3.0×10^{-6} from ingestion of produce inside the basin is due to Be.

Future Land Use - Noncarcinogenic Hazards (LAOCB)

For the future on-unit worker, the HIs were less than 1.0 for all constituents and exposure pathways.

For the future on-unit resident, the HIs exceeded 1.0 for soils at the LAOCB and pipeline. The highest HIs for these pathways were for the ingestion of soils, 20 at the LAOCB (primarily from CrVI) and 9 at the pipeline (primarily from TI).

Ecological Risk Assessment Results for the LAOCB/LAACB OU

The ecological risk assessment evaluated the likelihood of occurrence for adverse ecological effects from exposure to chemicals associated with the LAOCB/LAACB OU. The ecological setting of the unit is not unique. There are no known endangered, threatened, or special concern species on the unit, nor are the species that inhabit the unit rare in the region or considered to be of special societal value. The area of the unit is small and the habitat is low in diversity and productivity.

Based on characterization of the environmental setting and identification of potential receptor organisms, a CSM was developed to determine the complete exposure pathways through which ecological receptors could be exposed to COPCs. The focused evaluation addressed small mammals inhabiting the unit (represented by the cotton mouse) and amphibians inhabiting the LAACB (represented by the spring peeper frog). The ultimate assessment endpoint was the biodiversity and health of the ecological community encompassing the unit.

Interpretation of the ecological significance of the unit-related contamination at the LAOCB/LAACB indicated that there was no likelihood of unit-related radiological or nonradiological constituents causing significant impacts to the community of species in the vicinity of the unit. No constituents of potential concern identified in the soil at the LAOCB or LAACB are estimated to pose significant ecological risk based on their toxicity at the concentration at which they are present.

COCs and Human Health Risk-Based RGs

The LAOCB soil poses a potential threat to human health through exposure to sixteen primary COCs ($>1 \times 10^{-4}$ risk) and five secondary COCs (1×10^{-4} to 1×10^{-6} risk), and the LAOCB pipeline soil poses a potential threat to human health through exposure to four primary COCs and two secondary COCs. The primary and secondary COCs for the LAOCB soil and LAOCB pipeline soil are presented in Table 4.

RGs were developed for the primary COCs (primarily radionuclides) which represent greater than 99 percent of the total unit risk. RGs are human health risk-based calculations performed on COCs which are primary contributors of potential risk and/or adverse effects for the future resident scenario. Because the

Table 4
Operable Unit COCs and Risk Based RGOs

Contaminants of Concern (COCs)	Units	RGOs to Achieve 1E-06 Risk and HI of 1 Future Resident Adult and Child	RGOs to Achieve 1E-06 Risk and HI of 1 Future On-Unit Worker
Primary COCs (LAOCB Soils)			
Americium-241	pCi/g	2.60E+00	1.20E+01
Antimony-125	pCi/g	6.30E-02	5.30E-01
Cesium-137	pCi/g	3.70E-02	3.20E-01
Cobalt-60	pCi/g	8.80E-03	7.50E-02
Curium-244	pCi/g	4.90E+00	2.00E+01
Europium-152	pCi/g	2.10E-02	1.80E-01
Europium-154	pCi/g	1.90E-02	1.60E-01
Plutonium-238	pCi/g	3.60E+00	1.50E+01
Plutonium-239	pCi/g	3.40E+00	1.40E+01
Potassium-40	pCi/g	1.20E-01	1.20E+00
Strontium-90	pCi/g	3.90E-01	9.00E+01
Uranium-238+D	pCi/g	1.40E+00	1.20E+01
Uranium-234	pCi/g	2.50E+01	2.00E+02
Uranium-235+D	pCi/g	3.10E-01	2.60E+00
Aluminum	mg/kg	7.80E+04	ND
Cadmium	mg/kg	1.20E+01	ND
Chromium	mg/kg	3.40E+02	3.50E+02
Lead	mg/kg	4.00E+02	4.00E+02
Nickel	mg/kg	4.70E+02	ND
Vanadium	mg/kg	5.40E+01	ND
Secondary COCs (LAOCB Soils)			
Actinium-228		ND	ND
Thallium-208		ND	ND
Bismuth-214		ND	ND
Potassium-40		ND	ND
Beryllium		ND	ND
Primary COCs (Pipeline Soils)			
Arsenic	mg/kg	4.30E-01	ND
Thallium	mg/kg	6.10E+00	ND
Secondary COCs (Pipeline Soils)			
Thallium-208		ND	ND
Beryllium		ND	ND

ND - RGOs were not determined

hypothetical future scenarios usually yield the most conservative RG, future resident and on-unit worker RGs are presented in Table 4 for the primary COCs identified for the LAOCB soil and LAOCB pipeline soil.

Exposure to direct radiation from radiological constituents in soils/sediments at the LAOCB posed an estimated carcinogenic risk to the hypothetical future resident greater than all other evaluated exposure pathways. The primary contributors to the risk are ^{60}Co and ^{137}Cs .

The greatest risk to the hypothetical future resident at the LAOCB pipelines was estimated to be by the incidental ingestion of contaminated soils adjacent to the LAOCB pipelines. These risks are attributed to metals that occur naturally or are from farming activities prior to SRS. These metals are typically reported at concentrations above risk based concentrations in SRS soils.

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

Site-Specific Considerations

Site-specific considerations, based on the conclusions of the BRA and RFI/RI, which indicate significant risk to the future on-unit worker and future on-unit resident include:

- 1) LAOCB soils represent the greatest risk at the unit. Specifically, radionuclides represent greater than 99 percent of the total unit risk. Direct radiation exposure is the primary risk pathway and results in a 2×10^{-2} (i.e., 1 in 50 people would develop cancer due to exposure in an industrial setting) risk for a hypothetical future worker and 2×10^{-1} (1 in 5 people would develop cancer due to exposure in a residential setting) risk for a hypothetical future resident. ^{137}Cs (12%) and ^{60}Co (83%) are the primary risk drivers for the direct radiation pathway. The half-lives of ^{60}Co and ^{137}Cs are 5.2 years and 30.2 years, respectively.
- 2) Carcinogenic and noncarcinogenic risks posed by the pipeline soils are due to naturally occurring metals and radionuclides that are typical of SRS soils.
- 3) Radioactive contamination of the internal surface of the LAOCB pipeline has been documented to be approximately 300,000 dpm. Although this contamination does not currently represent a risk to

human health and the environment, future deterioration of the steel walls of the pipeline could potentially release contaminants to the environment and result in an unacceptable risk.

- 4) The LAACB, LAACB pipeline, and the area adjacent to the LAOCB are estimated to contribute low to nonexistent risk; therefore, No Action for these components of this operable unit is appropriate.
- 5) The LAOCB is underlain with a compact layer of dense clay (hardpan) and iron-cemented sediments which has limited migration of contaminants to the shallow soils (approximately 0-2 ft) below the LAOCB bottom.
- 6) The extent of groundwater contamination has not been completely defined; therefore, further characterization is required downgradient of identified tritium and VOC plumes.
- 7) The LAOCB and LAACB are in an area which has been recommended as an industrial zone by the Citizens Advisory Board and the *Savannah River Site Future Use Project Report* (DOE, 1996), precluding future residential use.
- 8) The existing monitoring wells around the LAOCB (LCO-1, -2, -3, and -4) were constructed in 1981 prior to the establishment of standard monitoring well construction specifications. All four wells have 30 foot screens that breach the "hardpan" clay horizon that has effectively minimized the migration of contaminants from the basin to the water table aquifer. Consequently, these wells potentially provide a conduit for the migration of unit COCs to the water table aquifer in the vicinity of the basin. The selected remedy should include abandonment/replacement of these wells, and state approval of these actions will be requested prior to field implementation.

VII. REMEDIAL ACTION OBJECTIVES AND DESCRIPTION OF CONSIDERED ALTERNATIVES FOR THE LAOCB/LAACB SOURCE CONTROL OPERABLE UNIT

Remedial Action Objectives

Remedial action objectives specify unit-specific contaminants, media of concern, potential exposure pathways, and remediation goals. The remedial action objectives are based on the nature and extent of contamination, threatened resources, and the potential for human and environmental exposure. Initially, preliminary remediation goals are developed based upon ARARs, or other information from the RFI/RI Report and the BRA. These goals should be modified, as necessary, as more information concerning the

unit and potential remedial technologies becomes available. Final remediation goals will be determined when the remedy is selected and shall establish acceptable exposure levels that are protective of human health and the environment.

ARARs are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal, State, or local environmental law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Three types of ARARs (action-, chemical-, and location-specific) have been developed to simplify identification and compliance with environmental requirements. Action-specific requirements set controls on the design, performance, and other aspects of implementation of specific remedial activities. Chemical-specific requirements are media-specific and health-based concentration limits developed for site-specific levels of constituents in specific media. Location-specific ARARs must consider Federal, State, and local requirements that reflect the physiographical and environmental characteristics of the unit or the immediate area. There were no action-specific, location-specific, or chemical-specific ARARs relevant to establishing remedial action objectives for the LAOCB/LAACB source unit.

The RFI/RI and BRA indicate that the secondary sources (i.e., LAOCB soil) associated with the LAOCB pose significant carcinogenic risk (approximately 2×10^{-1}) to human health. Threatened, endangered, or sensitive species are not found at the LAOCB/LAACB and the unit does not offer attractive or unique cover or forage opportunities for wildlife. Thus, ecological receptors are not at significant risk from the LAOCB/LAACB OU. In addition, although limited risk is associated with the LAOCB pipeline soils (approximately 2×10^{-5}), radioactivity detected inside the LAOCB pipelines does pose potential future risks associated with this source. The RFI/RI and BRA further indicate that risk and hazards to future residents for the LAACB and its pipeline are at or below 1×10^{-6} and 1.0, respectively. Therefore, No Action is warranted at the LAACB or the LAACB pipeline. Based on these conclusions, the CMS/FS was conducted to consider possible actions which could reduce the risks associated with the LAOCB soils and LAOCB pipeline. Since No Action is appropriate for the LAACB, no evaluation of alternatives in the CMS/FS was warranted for the LAACB.

Based on the risks posed by the radionuclides in the LAOCB soil, the general remedial action objectives for the LAOCB/LAACB OU are as follows:

1) to reduce risks to human health and the environment associated with:

a) external exposure to radiological constituents

- b) inhalation of radiological constituents
- c) ingestion of soil or produce grown in soil with radiological constituents, and
- d) prevent or mitigate the leaching and migration of COCs to unit groundwater

2) Achieve RGs established for unit soils

The predominant risk drivers at the LAOCB/LAACB OU are radionuclides in the LAOCB soils. Table 3 summarizes the risk posed by LAOCB soil, and illustrates that a majority of the risk is attributed to direct external radiation from ^{60}Co and ^{137}Cs , ingestion of ^{241}Am , ^{90}Sr , and ^{239}Pu , and inhalation of ^{99}Tc . Radionuclides are unique contaminants with a limited selection of remedial responses/technologies. Consequently, a preliminary list of treatment technologies that are potentially applicable to contamination associated with radioactive basins at SRS was developed at the Remediation Technology Roundtable, conducted on January 17 and 18, 1995 (WSRC, 1995c). The Remediation Technology Roundtable consisted of a panel of technical experts assembled to initiate critical, objective dialogue concerning potentially feasible remedial technologies and general response actions that could be used at radioactive waste sites such as the LAOCB. Technical merits and limitations of each technology and general response action were discussed in the open forum. The results of this forum indicate that the preferred remedial responses/technologies are stabilization and containment. The results of this forum, coupled with current guidance, provided the basis for screening and identifying technologies applicable to radioactive contaminants, and facilitated the selection of a preferred remedial alternative for the LAOCB in the CMS/FS and SB/PP.

RGs were developed for the primary COCs (see Table 4) which represent greater than 99 % of the total unit risk. These target risk based concentrations are for the industrial receptor based on the land-use determination for the area, and are the acceptable levels of COCs for unit soils that will not pose unacceptable risk to human health and the environment. In general, RGs for radionuclides (activity base) in soil can only be achieved through off-unit removal/disposal alternatives. Although the preferred stabilization or containment alternatives will not achieve activity based RGs, these alternatives meet the remedial action objectives of eliminating the risks posed by direct external radiation, ingestion, and inhalation of radionuclides and preventing or mitigating the leaching and migration of COCs to unit groundwater.

LAOCB Alternatives

The primary sources associated with the LAOCB (i.e., residual wastewater inside the LAOCB pipeline and piping associated with the drainage pad) are described in Section V. Residual wastewater is no longer present in the LAOCB, and its presence in the pipeline is unlikely because all piping was constructed as gravity feed, and no wastewater has been discharged through the piping for approximately 30 years. Consequently, remedial alternatives were not developed specifically for these sources.

The secondary sources pose a majority of the unit risk and include the LAOCB soil and LAOCB pipeline. The CMS/FS included detailed analyses for four LAOCB pipeline and six LAOCB soil alternatives which are described below. Included with the secondary source alternatives are remedial activities to address the contaminated vegetation in the LAOCB, the contaminated concrete and associated piping of the drainage pad on the north end of the LAOCB, and the existing monitoring wells around the basin that are potential contaminant migration conduits. Since primary and secondary COCs for the LAOCB soil and LAOCB pipeline soil are radionuclides and metals with very similar physical and chemical properties, the remedial alternatives identified in the CMS/FS are applicable to all unit primary and secondary COCs. These alternatives do not include discussion of the soil/debris consolidation facility (SDCF), a bulk disposal option currently under evaluation for the disposal of radiologically contaminated soils/debris at the SRS. If built, the SDCF would be located at the SRS and would accommodate low level radioactive soil and debris from many waste units at the SRS. The feasibility of constructing a SDCF is currently being evaluated and it is not known if disposal at the SDCF will be a viable option in the future. Therefore, this disposal option was not considered during the CMS/FS. If, after the ROD has been issued, DOE, EPA, SCDHEC, and stakeholders decide the LAOCB soil or pipeline should be disposed of at the SDCF, the ROD would be revised at that time.

Secondary Source Alternatives (LAOCB)

Alternative S-1. No Action

Under this alternative, no action would be taken at the LAOCB soils. EPA policy and regulations require consideration of the No Action alternative to serve as a basis against which other alternatives can be compared. Because No Action would be taken and the LAOCB soils would remain in their present condition, there are minimal costs related to normal SRS maintenance activities. The only reduction of risks resulting from the No Action alternative would be due to natural radioactive decay. Natural decay of ^{60}Co and ^{137}Cs , which pose 95% of the risk in the primary risk pathway (external radiation to hypothetical future resident), would reduce the external radiation risk by nearly 100% and 88%, respectively, over

approximately 90 years. Since five year reviews of the remedy are required for 30 years, the total present value estimate for these reviews for the next 30 years is \$280,000.

Alternative S-2. Backfill and Cap the LAOCB

This alternative involves the placement of clean backfill in the LAOCB followed by construction of a cap over the LAOCB. Initially, the waste unit would be prepared by abandoning the existing monitoring wells around the basin and clearing any vegetation, fencing, and other physical obstructions immediately surrounding the LAOCB area. In addition, the contaminated soils, vegetation, and debris on the walls of the basin and the staging area on the north end of the basin would be pushed into the bottom of the basin. The basin would then be backfilled and compacted to grade. After sufficient compaction, an engineered cap would be constructed over the LAOCB to minimize surface infiltration and thereby reduce the potential for contaminant migration. A low permeability engineered cap would be sufficient to minimize infiltration, intrusion, and surface erosion. The cover design would be approved by the EPA and SCDHEC prior to construction. The cap would cover an area of approximately 0.5 acres (21,780 square feet). The capped area will be maintained and Institutional Controls will remain in place as long as the waste remains a threat to human health or the environment. Based on the known half-lives of the predominant radiological risk drivers (i.e., ^{60}Co and ^{137}Cs), ^{60}Co will have gone through approximately 20 half-lives and ^{137}Cs will have gone through approximately 3.5 half-lives over a 100 year duration.

A properly engineered cap would function as a physical barrier to prevent direct human exposure to soil-borne contamination and thus be protective of human health and the environment. Capping is a performance-based engineering approach since it does not reduce the total mass of COCs and cannot achieve RGs. Three feet of soil cover is required to reduce the annual effective dose associated with continuous exposure to the ^{137}Cs and ^{60}Co in the basin by over 99% and to within regulatory and DOE limits. In addition, a properly maintained cap would minimize infiltration and subsequent leaching of contamination from unsaturated soil to the groundwater. Under this remedial alternative, remedial action objectives would be satisfied by: (1) limiting infiltration into the area and thereby reducing the leaching of primary and secondary COCs to unit groundwater, and (2) preventing human or ecological access and thereby reducing risks to human health and the environment. The total present value estimate for this alternative is \$1,430,000. These costs include operation and maintenance of the cap for 30 years, and review of remedy every five years for 30 years, as required by the NCP.

Alternative S-3. Backfill, Install Slurry Cut-Off Walls around the LAOCB, and Cap

This alternative involves the placement of clean backfill in the LAOCB followed by installation of a vertical cut-off wall around the LAOCB cap area and construction of a cap over the LAOCB. Initially, the waste unit would be prepared by abandoning the existing monitoring wells around the basin and clearing any vegetation, fencing, and other physical obstructions immediately surrounding the LAOCB area. In addition, the contaminated soils, vegetation, and debris on the walls of the basin and the staging area on the north end of the basin would be pushed into the bottom of the basin. The basin would then be backfilled and compacted to grade. After sufficient compaction, a vertical cut-off wall (slurry wall) would be installed by excavating a trench around the LAOCB down to the hardpan clay layer located just below the bottom of the LAOCB, and filling with a low permeability soil-bentonite or cement-bentonite slurry. An engineered cap would be constructed over the LAOCB to minimize surface infiltration and reduce the potential for contaminant migration. Coupled with the hardpan clay layer located just below the bottom of the LAOCB, this slurry wall/cap would form a complete low-permeability containment unit.

The low permeability engineered cap would have the same characteristics as identified in Alternative S-2. The capped area will be maintained and Institutional Controls will remain in place as long as the waste remains a threat to human health or the environment.

Under this alternative, remedial action objectives would be satisfied by: (1) limiting infiltration into the area and thereby preventing the migration of primary and secondary COCs to groundwater, and (2) preventing human or ecological access and thereby reducing risks to human health and the environment. This alternative, assuming an approximate backfill/cap thickness of four feet, is estimated to reduce the radioactive dose (direct radiation exposure) received from ^{60}Co and ^{137}Cs at the LAOCB by nearly 100 percent. The total present value estimate for this alternative is \$3,430,000. These costs include operation and maintenance of the cap for 30 years, and review of remedy every five years for 30 years, as required by the NCP.

Alternative S-4. In-situ Solidification/Stabilization, Backfill, and Cap

This alternative involves the in-situ solidification/stabilization (S/S) of the top two feet of soil in the bottom of the LAOCB, placement of clean backfill in the LAOCB to grade, followed by construction of a cap over the LAOCB. Initially, the waste unit would be prepared by abandoning the existing monitoring wells around the basin and clearing any vegetation, fencing, and other physical obstructions immediately surrounding the LAOCB area. In addition, the contaminated soils, vegetation, and debris on the walls of the basin and the staging area on the north end of the basin would be pushed into the bottom of the basin. The soil and debris would then be solidified/stabilized to a depth of approximately two feet below the

current basin bottom. In-situ S/S would involve mixing the S/S reagents into the waste by some mechanical means such as a jet-grouting system or a long-reach backhoe fitted with a rotary tine. A treatability study has been conducted on LAOCB soils to identify S/S reagents that effectively immobilize unit-specific contaminants. A mixture of Portland Cement, bentonite, and sodium silicate was found to effectively immobilize LAOCB contaminants of concern and would be used to in-situ S/S LAOCB soils. Following S/S, the remaining depression would be backfilled to grade and a low permeability engineered cap sufficient to minimize infiltration, intrusion, and surface erosion would be constructed over the basin. The cover design would be approved by the EPA and SCDHEC prior to construction. The capped area will be maintained and Institutional Controls will remain in place as long as the waste remains a threat to human health or the environment.

In-situ S/S does not reduce the total mass of COCs and cannot in itself achieve RGs. However, it is a proven performance based engineering approach that reduces the mobility of primary and secondary COCs. Based on results of a literature search and a treatability study performed on LAOCB soils, the in-situ S/S reagents are considered effective at reducing the leachability of contaminants. Specifically, the various S/S reagent samples (with LAOCB soil) were subjected to toxicity characteristic leaching procedure (TCLP) and the extended American National Standard (ANS) 16.1 procedure to simulate leaching of contaminants over time. Analysis of the two leaching tests performed on LAOCB soil samples amended with S/S reagents demonstrated that all of the samples released 0.41 % and 1.61 % or less of gross alpha and gross beta, respectively (WSRC, 1996c).

Under this alternative, contamination in the basin would be immobilized and covered with clean soil and a cap. These actions would meet remedial action objectives by: (1) preventing infiltration into the area through capping and immobilizing contaminants present in the basin via in-situ S/S, and thereby preventing migration of primary and secondary COCs to groundwater, and (2) preventing human or ecological access and thereby reducing risks to human health and the environment. In addition, assuming an approximate backfill/cap thickness of four feet, this alternative is estimated to reduce the radioactive dose (direct radiation exposure) received from ^{60}Co and ^{137}Cs at the LAOCB by nearly 100%. The total present value estimate for this alternative is \$3,580,000. These costs include operation and maintenance of the cap for 30 years, and review of the remedy every five years for 30 years, as required by the NCP.

Alternative S-5. Ex-situ Stabilize, Backfill, & Cap

This alternative involves the ex-situ S/S of the top two feet of soil in the bottom of the LAOCB, placement back in the LAOCB, placement of clean backfill in the remaining depression, followed by construction of a cap over the LAOCB. Initially, the waste unit would be prepared by abandoning the existing monitoring

wells around the basin and clearing any vegetation, fencing, and other physical obstructions immediately surrounding the LAOCB area. Due to radiological control concerns with the excavation of the radioactive contamination in the basin, the soil would be stabilized prior to excavation for ex-situ S/S. The soil would be solidified/stabilized to a depth of approximately two feet below the current basin bottom as described for Alternative S-4. The top two feet of soil in the bottom of the basin would then be excavated and ex-situ S/S. Following placement of the treated basin soil back in the LAOCB, contaminated soils, vegetation, and debris on the walls of the basin and the staging area on the north end of the basin would be pushed into the bottom of the basin on top of the stabilized soil. The basin would be backfilled with clean soil and compacted to original grade. After sufficient compaction, an engineered cap would be constructed over the LAOCB. The treated soil and the engineered cap would minimize surface infiltration and reduce the potential for contaminant migration. The low permeability engineered cap would have the same characteristics as identified in Alternative S-2. The capped area will be maintained and Institutional Controls will remain in place as long as the waste remains a threat to human health or the environment.

As discussed under Alternative S-4, this alternative does not reduce the total mass of COCs and cannot in itself achieve RGs. However, it is a proven performance-based engineering approach that reduces the mobility of primary and secondary COCs. In addition, as discussed under Alternative S-4, results of a literature search and a treatability study performed on LAOCB soils indicate S/S reagents are considered effective at reducing the mobility of primary and secondary COCs. Under this alternative, contamination in the basin would be excavated, immobilized, replaced in the LAOCB, and a cap constructed.

This alternative would meet remedial action objectives by: (1) preventing infiltration into the area through capping and immobilizing contamination present in the basin through ex-situ S/S, thereby preventing migration of primary and secondary COCs to groundwater, and (2) preventing human or ecological access and thereby reducing risks to human health and the environment. In addition, assuming an approximate backfill/cap thickness of four feet, this alternative is estimated to reduce the radioactive dose (direct radiation exposure) received from ^{60}Co and ^{137}Cs at the LAOCB by nearly 100%. The total present value estimate for this alternative is \$4,370,000. These costs include operation and maintenance of the cap for 30 years, and the review of remedy every five years for 30 years, as required by the NCP.

Alternative S-6. Excavation & Off-Unit Disposal

This alternative involves the excavation and *off-unit* disposal of the top two feet of soil from the bottom of the LAOCB, and contaminated soils, vegetation, and debris on the walls of the basin and the staging area on the north end of the basin. Treatment (i.e., stabilization) of the LAOCB soils would first be conducted to ensure optimal waste handling characteristics. Following pretreatment, a backhoe or trackhoe would be

used to excavate contaminated material in the LAOCB to a depth of approximately two feet below the current basin bottom. Confirmation soil samples would be collected and analyzed periodically during excavation to verify that all soil exceeding concentration-based remediation goals was recovered. Following excavation, the soil may require further treatment for waste handling purposes and packaging and disposal requirements. The contaminated material would then be placed directly into lined haul trucks for transport from the waste unit to the disposal facility [Nevada Test Site (NTS) near Mercury, Nevada]. Upon completion of contaminated material removal, the LAOCB would be backfilled with clean soil and compacted to grade.

By removing the source of contamination, this alternative would eliminate all risks associated with the LAOCB soils and meet the remedial action objectives by eliminating any risk of contaminant migration to groundwater and risk to human health and the environment. Since the source term is removed under this alternative, review of remedy every five years for 30 years would not be required. The total present value estimate for this alternative is \$9,100,000.

Secondary Source Alternatives (LAOCB Pipeline)

Alternative P-1. No Action

Under this alternative, no action would be taken at the LAOCB pipeline. EPA policy and regulations require consideration of the No Action alternative to serve as a basis against which other alternatives can be compared. Because no action would be taken and the LAOCB pipeline would remain in its present condition, there are minimal costs related to normal SRS maintenance activities. Under the No Action alternative, there would be no reduction or mitigation of current or future risks associated with the pipelines. Since five year reviews of the remedy would be in conjunction with the reviews for the LAOCB soil remedy, the estimated cost for these reviews for the next 30 years is \$0. The total present value estimate for this alternative is \$0.

Alternative P-2. Capping

This alternative involves the construction of a low permeability cap over the LAOCB pipeline area. Initially, the waste unit would be prepared by clearing any vegetation, fencing, and other physical obstructions immediately surrounding the LAOCB pipeline area. After the area is prepared, an engineered cap would be constructed over the LAOCB pipeline to minimize surface infiltration and thereby reduce the potential for contaminant migration. The low permeability engineered cap would be designed to minimize infiltration, intrusion, and surface erosion. The cover design would be approved by the EPA and SCDHEC prior to construction. The cap would cover an area of approximately 0.5 acres (21,780 square feet). The

capped area will be maintained and Institutional Controls will remain in place as long as the waste remains a threat to human health or the environment.

This alternative would meet the remedial action objectives by: (1) minimizing infiltration into the pipeline area, thereby preventing migration of contaminants to groundwater, and (2) preventing intrusion to the pipeline area, thereby reducing risk to human health and the environment. Since five year reviews of the remedy would be in conjunction with the LAOCB soil, the additional estimated present value for these reviews for the next 30 years is \$0. The total present value estimate for this alternative is \$730,000.

Alternative P-3. In-situ Solidification/Stabilization and Disposal in the LAOCB

This alternative involves the in-situ S/S, excavation, and on-unit disposal of the LAOCB pipeline and associated soils in the LAOCB. The pipelines would first be filled with grout to minimize the potential release of residual contaminants from inside the pipelines during excavation. A backhoe or trackhoe would then be used to excavate the LAOCB pipeline. The pipelines would be cut into manageable sections for the purpose of moving and minimizing required disposal space. Confirmation soil samples would be collected and analyzed periodically during excavation to verify that all soil exceeding concentration-based remediation goals was recovered. The pipeline sections and associated soils would be placed directly into the LAOCB and subsequently solidified/stabilized to create a monolith and further reduce the mobility of pipeline contaminants. When pipeline and soil removal and disposal are completed, the LAOCB pipeline area would be backfilled with clean soil and compacted to grade.

Because the source of contamination would be removed under this alternative, remedial action objectives would be met by eliminating any risk to groundwater, human health, or the environment caused by the LAOCB pipeline area. Since five year reviews of the remedy would be in conjunction with the LAOCB soil, the additional estimated present value for these reviews for the next 30 years is \$0. The total present value estimate for this alternative is \$990,000.

Alternative P-4. In-situ Solidification/Stabilization and Disposal at the Nevada Test Site

This alternative involves the in-situ S/S, excavation, and *off-unit* disposal of the LAOCB pipeline and associated soils. The pipelines would first be filled with grout to minimize the potential release of residual contaminants from inside the pipelines during excavation. A backhoe or trackhoe would be used to excavate the LAOCB pipeline. The pipeline sections would then be cut into manageable sections for the purpose of moving and minimizing required disposal space. Confirmation soil samples would be collected and analyzed periodically during excavation to verify that all soil exceeding concentration-based remediation goals was recovered. The pipelines and associated soil would then be placed directly into

lined haul trucks for transport from the waste unit to the disposal facility (NTS near Mercury, Nevada). Upon the completion of the excavation of contaminated pipeline and soil, the LAOCB pipeline area would be backfilled with clean soil and compacted to grade.

Because the source of contamination would be removed under this alternative, remedial action objectives would be met by eliminating any risk to groundwater, human health, or the environment caused by the LAOCB pipeline area. Since five year reviews of the remedy would be in conjunction with the LAOCB soil, the additional estimated present value for these reviews for the next 30 years is \$0. The total present value estimate for this alternative is \$4,630,000.

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF THE ALTERNATIVES

Each of the remedial alternatives was evaluated using the nine criteria established by the NCP. The criteria were derived from the statutory requirements of CERCLA Section 121. The criteria are:

- overall protection of human health and the environment,
- compliance with ARARs,
- long-term effectiveness and permanence,
- reduction of toxicity, mobility, or volume through treatment,
- short-term effectiveness,
- implementability,
- cost,
- state acceptance, and
- community acceptance.

In selecting the preferred alternative, the above criteria were used to evaluate the alternatives developed in the focused CMS/FS (WSRC, 1997b). Seven of the criteria were used to evaluate all the alternatives, based on human health and environmental protection, cost, feasibility, and implementability issues. The preferred alternative was further evaluated based on the final two criteria: state acceptance and community acceptance.

Tables 5 and 6 present the evaluation of the soil and pipeline remedial alternatives, respectively. Summaries of the comparative analysis of alternatives are provided below.

Table 5
Comparative Analysis of Soil/Sediment Alternatives
LAOCB

Criterion	LAOCB Soil Remedial Alternatives					
	Alternative S-1 No Action	Alternative S-2 Capping	Alternative S-3 Slurry Cut-Off Wall & Capping	Alternative S-4 In situ S/S & Capping	Alternative S-5 Ex situ S/S & Capping	Alternative S-6 Disposal at the Nevada Test Site
Overall Protectiveness						
Human Health	Not Protective	Protective	Protective	Protective	Protective	Protective
Environment	Protective as long as clay layer beneath Basin restricts migration	Protective	Protective	Protective	Protective	Protective
Compliance with ARARs						
Chemical-specific	Meets TSCA/UMTRCA levels; would not meet 40 CFR 191 or DOE Order 5400.5 (TBC) under hypothetical future conditions	Meets TSCA/UMTRCA levels; Complies with 40 CFR 191 and DOE Order 5400.5 (TBC)	Meets TSCA/UMTRCA levels; Complies with 40 CFR 191 and DOE Order 5400.5 (TBC)	Meets TSCA/UMTRCA levels; Complies with 40 CFR 191 and DOE Order 5400.5 (TBC)	Meets TSCA/UMTRCA levels; Complies with 40 CFR 191 and DOE Order 5400.5 (TBC)	Meets TSCA/UMTRCA levels; Complies with 40 CFR 191 and DOE Order 5400.5 (TBC)
Location-specific	Not Applicable	None	None	None	None	None

Table 5 (continued)
Comparative Analysis of Soil/Sediment Alternatives
LAOCB

Criterion	LAOCB Soil Remedial Alternatives					
	Alternative S-1 No Action	Alternative S-2 Capping	Alternative S-3 Slurry Cut-Off Wall & Capping	Alternative S-4 In situ S/S & Capping	Alternative S-5 Ex situ S/S & Capping	Alternative S-6 Disposal at the Nevada Test Site
Action-specific	None	Requires NESHAPs air modeling & permitting; RCRA cap performance standards; erosion control plan; OSHA worker health & safety plan	Requires NESHAPs air modeling & permitting; RCRA cap performance standards; erosion control plan; OSHA worker health & safety plan	Requires NESHAPs air modeling & permitting; RCRA cap performance standards; erosion control plan; OSHA worker health & safety plan	Requires NESHAPs air modeling & permitting; RCRA cap performance standards; erosion control plan; OSHA worker health & safety plan	Requires NESHAPs air modeling & permitting; RCRA cap performance standards; erosion control plan; OSHA worker health & safety plan
Long-Term Effectiveness and Permanence						
Magnitude of residual risks	Residual risks could be high, particularly in the absence of institutional controls; clay layer beneath Basin could retard impact to groundwater	Much reduced over current conditions; capping and clay layer would retard migration of COCs	Residual risks would be lower than Alternative 2, total encapsulation of COCs	Residual risk lower than Alternatives 2 and 3 due to grouting of the contaminants (protection of the environment)	Residual risk would be the same as Alternative 4	Residual risk would be minimal; contaminated soils would be permanently removed

Table 5 (continued)
Comparative Analysis of Soil/Sediment Alternatives
LAOCB

Criterion	LAOCB Soil Remedial Alternatives					
	Alternative S-1 No Action	Alternative S-2 Capping	Alternative S-3 Slurry Cut-Off Wall & Capping	Alternative S-4 In situ S/S & Capping	Alternative S-5 Ex situ S/S & Capping	Alternative S-6 Disposal at the Nevada Test Site
Adequacy of controls	Existing institutional controls are effective for the protection of human health, but cannot be guaranteed; adequacy of the clay layer has proven effective, but can not be verified	Existing and supplemental institutional controls would be effective; cap and the clay layer beneath the Basin would retard migration of COCs	Existing and supplemental institutional controls would be effective; slurry wall, cap and the clay layer beneath the Basin would retard migration of COCs	Existing and supplemental institutional controls would be effective and grouting of the contaminated soils would further limit risk to the environment	Existing and supplemental institutional controls would be effective and grouting of the contaminated soils would further limit risk to the environment	No controls required; could be released for unrestricted land use
Reduction of Toxicity, Mobility or Volume						
Treatment type	No active treatment	No active treatment	No active treatment	Stabilization/solidification of the contaminated soil	Stabilization/solidification of the contaminated soil	None

Table 5 (continued)
Comparative Analysis of Soil/Sediment Alternatives
LAOCB

Criterion	LAOCB Soil Remedial Alternatives					
	Alternative S-1 No Action	Alternative S-2 Capping	Alternative S-3 Slurry Cut-Off Wall & Capping	Alternative S-4 In situ S/S & Capping	Alternative S-5 Ex situ S/S & Capping	Alternative S-6 Disposal at the Nevada Test Site
Reduction of toxicity, mobility or volume	None through treatment	Capping and the clay layer beneath the Basin would effectively reduce contaminant mobility as long as cap integrity is maintained; not a permanent reduction in contaminant mobility	Slurry wall, capping, and the clay layer beneath the Basin would effectively reduce contaminant mobility as long as cap integrity is maintained; not a permanent reduction in contaminant mobility	Permanently reduce contaminant mobility in the soils	Permanently reduce contaminant mobility in the soils	Contaminated soils removed, and relocated
Short-Term Effectiveness						
Risk to remedial workers	None; would involve no handling of contaminated media	Minimal	Minimal	Low	Medium; volume of soils excavated: 760 m ³ (27,000 ft ³ , 1,000 yd ³)	Medium to high; volume of soils excavated and transported: 760 m ³ (27,000 ft ³ , 1,000 yd ³)
Risk to community	Negligible	Minimal	Minimal	Minimal	Minimal	Medium; would involve transport of soils to the NTS
Construction schedule	Immediately implementable	3 months	6 months	12 months	15 months	3 months

Table 5 (continued)
Comparative Analysis of Soil/Sediment Alternatives
LAOCB

Criterion	LAOCB Soil Remedial Alternatives					
	Alternative S-1 No Action	Alternative S-2 Capping	Alternative S-3 Slurry Cut-Off Wall & Capping	Alternative S-4 In situ S/S & Capping	Alternative S-5 Ex situ S/S & Capping	Alternative S-6 Disposal at the Nevada Test Site
Implementability						
Potential concerns	Potential for public concern if no action is implemented	Potential for public concern since no treatment is performed	Potential for public concern since no treatment is performed	None	Medium; would require pre-excitation treatment for waste handling purposes	High; would involve transport of soils outside SRS boundaries; would require pre- & post-excitation treatment for waste handling & packaging purposes
Relative implementability	Readily implementable	Readily implementable, but would require much more effort than No Action	Readily implementable; would require more effort than capping alone (Alt 2)	Readily implementable; would require more effort than capping alone (Alt 2)	Implementable; however, waste handling may cause down time during remediation; also requires pre-excitation treatment	Implementable; however, waste handling may cause down time during remediation; also requires pre- & post-excitation treatment

Table 5 (continued)
Comparative Analysis of Soil/Sediment Alternatives
LAOCB

Criterion	LAOCB Soil Remedial Alternatives					
	Alternative S-1 No Action	Alternative S-2 Capping	Alternative S-3 Slurry Cut-Off Wall & Capping	Alternative S-4 In situ S/S & Capping	Alternative S-5 Ex situ S/S & Capping	Alternative S-6 Disposal at the Nevada Test Site
Cost*						
Basis for O&M costs	30 years	30 years	30 years	30 years	30 years	Not applicable
Present worth capital costs	\$0	\$1,000,000	\$3,000,000	\$3,150,000	\$3,940,000	\$9,100,000
Present worth O&M costs	\$280,000	\$430,000	\$430,000	\$430,000	\$430,000	\$0
Total present worth costs	\$280,000	\$1,430,000	\$3,430,000	\$3,580,000	\$4,370,000	\$9,100,000

*Costs are developed for comparison purposes only and are not intended to forecast actual expenditures.
S/S = Stabilization/Solidification

Table 6
Comparative Analysis of Pipeline Alternatives
LAOCB

Criterion	LAOCB Pipelines Remedial Alternatives			
	Alternative P-1 No Action	Alternative P-2 Capping	Alternative P-3 In situ S/S Excavation & Disposal in the LAOCB	Alternative P-4 In situ S/S Excavation and Disposal at the Nevada Test Site
Overall Protectiveness				
Human Health	Not Protective	Protective	Protective	Protective
Environment	Not Protective	Protective	Protective	Protective
Compliance with ARARs				
Chemical-specific	Compliance with DOE Order 5400.5 cannot be determined until further investigation is conducted	Would comply with DOE Order 5400.5	Would comply with DOE Order 5400.5	Would comply with DOE Order 5400.5
Location-specific	None	None	None	None
Action-specific	None	Requires compliance with RCRA cap performance standards; erosion control plan; OSHA worker health & safety plan	Requires NESHAPs air modeling & permitting; erosion control plan; OSHA worker health & safety plan	Requires NESHAPs air modeling & permitting; erosion control plan; OSHA worker health & safety plan
Long-Term Effectiveness and Performance				
Magnitude of residual risks	Risk would include intrusion into the pipeline, and future release of contaminants due to degradation of the pipeline integrity	Residual risks would be lower than Alternative 1; capping would decrease access, migration, and external exposure potential	Residual risk would be minimal; the pipeline would be grouted in place and permanently removed; contaminants would be transferred to the basin to be stabilized further	Residual risk would be minimal; the pipeline would be permanently removed

Table 6 (continued)
Comparative Analysis of Pipeline Alternatives
LAOCB

Criterion	LAOCB Pipelines Remedial Alternatives			
	Alternative P-1 No Action	Alternative P-2 Capping	Alternative P-3 In situ S/S Excavation & Disposal in the LAOCB	Alternative P-4 In situ S/S Excavation and Disposal at the Nevada Test Site
Adequacy of controls	Existing pipeline appears to prevent migration of radionuclides, but migration or protection against human intrusion cannot be guaranteed	Capping would further reduce migration of contaminants by limiting infiltration	No controls required; could be released for unrestricted land use	No controls required; could be released for unrestricted land use
Reduction of Toxicity, Mobility or Volume				
Treatment type	No active treatment	No active treatment	In-Situ S/S	In-Situ S/S
Reduction of toxicity, mobility, or volume	None through treatment	None through treatment, but capping would decrease the mobility of contaminants	Grouting the pipeline would reduce mobility	Grouting the pipeline would reduce mobility
Short-Term Effectiveness				
Risk to remedial workers	None; would involve no handling of pipelines	Minimal; would involve no contact with pipelines	Medium; excavation would require contact with the pipelines, however residual contaminants would be immobilized before handling	High; excavation and loading would require intimate contact with the pipelines, however, residual contaminants would be immobilized before handling
Risk to community	Negligible	Negligible	Minimal	Medium; would involve transport of contaminated media to the NTS
Construction schedule	Immediately implementable	2 months	2 months	3 months

Table 6 (continued)
Comparative Analysis of Pipeline Alternatives
LAOCB

Criterion	LAOCB Pipelines Remedial Alternatives			
	Alternative P-1 No Action	Alternative P-2 Capping	Alternative P-3 In situ S/S Excavation & Disposal in the LAOCB	Alternative P-4 In situ S/S Excavation and Disposal at the Nevada Test Site
Implementability				
Potential concerns	May prompt public concern	None	Medium; would involve grouting, excavation, cutting pipeline to manageable lengths, and exposure to pipelines	High; would involve grouting excavation, cutting pipeline to manageable lengths, loading, and transport of pipelines long distance
Relative implementability	Readily implementable	Readily implementable; capping would require significantly more effort than Alternative 1	Implementable; however, would require more effort than Alternative 2 due to potential for worker exposure	Implementable; however, would require more effort than Alternative 3 due to transport
Cost¹				
Basis for O&M costs	30 years	30 years	Not applicable	Not applicable
Present worth capital costs	See Note 2 below	\$560,000	\$990,000	\$4,630,000
Present worth O&M costs	See Note 2 below	\$170,000	\$0	\$0
Total present worth costs	See Note 2 below	\$730,000	\$990,000	\$4,630,000

1. Costs are developed for comparison purposes only and are not intended to forecast actual expenditures.

2. The cost of remedy reviews would be included in those for the LAOCB OU, depending on the remedy selected for the LAOCB.

S/S = Stabilization/Solidification

LAOCB Soil Alternatives

Overall Protection of Human Health and the Environment (LAOCB Soil)

The No Action alternative would not be protective of human health and the environment. The existence of the clay layer (hardpan) beneath the Basin adequately retards the migration of COCs through the vadose zone, however, it provides no means of verifying whether contaminants would impact groundwater in the future.

Remaining alternatives being considered would all be protective of human health and the environment. With the exception of Alternative S-6 (Disposal at NTS), all other alternatives would involve capping, which would: (1) act as a barrier that would deter human access to contaminated media; (2) minimize infiltration and leaching of contaminants from soil to groundwater; (3) act as shielding to reduce radiation exposure to hypothetical receptors to within acceptable levels; and (4) serve as redundant protective feature for those alternatives that involve treatment as a primary means of remediating contaminated soil.

Compliance with ARARs (LAOCB Soil)

The chemical-specific ARARs associated with the LAOCB include concentration-based standards for Ra and Th in surface and subsurface soil specified in Uranium Mill Tailings Radiation Control Act (UMTRCA). No detectable activities of $^{226/228}\text{Ra}$, ^{230}Th , or ^{232}Th were present in the basin soil. ^{234}Th (a daughter of ^{238}U) was present in significant activities in the basin soil.

EPA regulation 40 CFR 192 and DOE Order 5400.5 are considered relevant and appropriate and to-be-considered information, respectively. The EPA standard specifies an allowable annual effective dose to any member of the public resulting from nuclear power plant operations. The allowable effective dose rate is 25 mrem/year. The DOE Order specifies an allowable annual effective dose to any member of the public resulting from all DOE operations of 100 mrem/year. With the exception of the No Action alternative (Alternative S-1), an evaluation of remaining alternatives using very conservative assumptions indicates that implementation of the alternatives would meet the allowable effective dose rates under 40 CFR 192 and DOE Order 5400.5.

Action-specific ARARs identified for the evaluated alternatives are generally similar, however, no ARARs are identified for the No Action alternative. All remaining alternatives require National Emissions Standards for Hazardous Air Pollutants (NESHAPs) air modeling, county erosion control plans, and OSHA

health and safety plans. RCRA capping performance standards are required for all alternatives except No Action and *off-unit* disposal. Alternative S-6 requires transportation of radioactive materials within SRS boundaries and off site to the NTS facility, which would require adherence to DOE Order 5480.3 and 49 CFR 172 through 203.

Long-Term Effectiveness and Permanence (LAOCB Soil)

Long-term effectiveness and permanence can be measured in broad terms by (1) the magnitude of residual risks associated with the waste unit, and (2) the adequacy of controls after implementation of the remedial alternative. Of the alternatives being considered, the No Action alternative is the least effective alternative in terms of the magnitude of residual risks after implementation since it would leave all contaminated media in place without the benefit of treatment. Alternatives S-2 and S-3, which involve the capping of all contaminated media and vertical barriers, would significantly reduce the magnitude of residual risks over No Action since they would minimize infiltration reaching the waste, however, Alternatives S-2 (Capping) and S-3 (Capping and Slurry Wall) do not involve any form of treatment that would permanently reduce the magnitude of residual risk. With the exception of No Action (Alternative S-1) and Alternative S-6 (Disposal at NTS), all other alternatives involve capping and treatment of contaminated media. Alternative S-6 involves *off-unit* disposal of all contaminated soil above concentration-based remediation goals but does not involve capping. Alternatives S-4 (In-situ S/S), S-5 (Ex-situ S/S), and S-6 (Disposal at NTS) offer a greater reduction in the magnitude of residual risks than would Alternatives S-2 (Capping) and S-3 (Capping and Slurry Wall).

Alternatives S-4 (In-situ S/S) and S-5 (Ex-situ S/S) involve some form of treatment that would permanently reduce the magnitude of on-unit residual risks by reducing contaminant mobility and/or volume. Alternative S-6 involves no form of treatment to reduce the magnitude of residual risk associated with contaminated media, however, this alternative involves the disposal of contaminated soil at the NTS facility and would effectively remove all residual risk at the unit.

With respect to contaminated soil, Alternative S-6 (Disposal at NTS) offers the greatest reduction in residual risk since it would permanently remove all contaminated soil at concentrations above concentration-based remediation goals from the LAOCB waste unit. Residual concentrations left in soil would not pose a significant risk to human health or the environment. Alternatives S-4 (In-situ S/S) and S-5 (Ex-situ S/S) would immobilize soil-borne contaminants. The residual risks associated with Alternative S-5 would be slightly less than that of Alternative S-4 because the treatment of all known soil-borne

contamination at the LAOCB waste unit would be verified by confirmation sampling under Alternative S-5, whereas treatment of all known soil-borne contamination would not be confirmed under Alternative S-4.

Existing SRS institutional controls would be adequate for the protection of human health as long as the institutional controls are maintained. In the absence of existing controls, the No Action alternative would not be protective of human health. Based upon the hypothetical scenario that institutional controls cannot be guaranteed and/or proposed caps could be allowed to fail, the need for controls to maintain protectiveness would decrease corresponding to the extent to which contaminated media are treated to permanently reduce the magnitude of residual risks. Consequently, the need for controls is greatest for alternatives that do not treat or remove any of the contaminated media (Alternatives S-1 - No Action, S-2 - Capping, and S-3 - Capping and Slurry Wall) followed by alternatives that treat all known contaminated soil at the LAOCB waste unit (Alternatives S-4 - In-situ S/S and S-5 - Ex-situ S/S). Alternative S-6 (Disposal at NTS) would require the least controls of all alternatives being considered since it would involve the permanent removal of all contaminated soil known to exceed concentration-based remediation goals. With the exception of restrictions on groundwater use, no controls would be required for the LAOCB waste unit under Alternative S-6.

Reduction of Toxicity, Mobility, or Volume (LAOCB Soil)

Alternatives S-1 (No Action), S-2 (Capping), S-3 (Capping and Slurry Walls), and S-6 (Disposal at NTS) offer no form of active treatment and, therefore, do not satisfy the NCP preference for remedial alternatives that offer a reduction in contaminant toxicity, mobility, or volume. All other alternatives being considered offer some form of active treatment that would permanently reduce contaminant toxicity, mobility, or (contaminated media) volume. The treatment technology being considered for treating LAOCB contaminated soil is stabilization/solidification by grouting (soil only), which reduces contaminant mobility.

Short-Term Effectiveness (LAOCB Soil)

The short-term risks to remedial workers increases with the volume of contaminated media directly handled or processed and project duration. Handling (e.g., excavating, moving) and/or processing (e.g., treating) contaminated media increases the risk of remedial worker exposure to radiation effects. In addition, remedial workers are exposed to potential construction-related risks (e.g., falls, cuts, heavy equipment operation) which increase with corresponding increases in project duration, however, potential short-term risks to remedial workers should be manageable for all alternatives being considered. With

strict adherence to project health and safety plans, it should be possible to maintain short-term risks of all considered alternatives within acceptable limits.

The potential risk to remedial workers would be lowest for the No Action alternative, followed by Alternative S-2 (Capping) which involves no or very limited handling or processing of contaminated media. The No Action alternative requires no time in the field, whereas the estimated time to complete Alternative S-2 (Capping) is four months once fieldwork begins. Alternative S-6 (Disposal at NTS) would not require an extensive timeframe to complete the remediation beyond that of Alternative S-2.

The alternatives posing the greatest potential risks to remedial workers would be Alternatives S-5 (Ex-situ S/S) and S-6 (Disposal at NTS) because they involve the direct handling and processing of the greatest volume of contaminated media. Standby time would be anticipated for these alternatives to address health and safety issues since these alternatives would involve extensive handling and/or processing of contaminated soil. Work stoppages would significantly impact the time needed to complete these alternatives. After mobilization to the field, the estimated time to complete Alternatives S-5 and S-6 is two months.

All alternatives being considered would pose negligible or very low risks to the community. Under Alternatives S-1 (No Action), S-2 (Capping), S-3 (Capping and Slurry Walls), S-4 (In-situ S/S), and S-5 (Ex-situ S/S), the risks posed to the community would be negligible since they would not include *off-unit* transport of contaminated media. Alternative S-6 involves transport of contaminated soil to the NTS facility near Mercury, Nevada, 2,200 miles from the LAOCB waste unit, and involves more risk than the other alternatives.

Implementability (LAOCB Soil)

Alternative S-1 (No Action) would be the most implementable alternative being considered since it would not involve any type of construction or remedial actions beyond existing institutional controls, however, the No Action alternative could potentially arouse public concern since it would pose a potential threat to the environment. Alternative S-2 (Capping) would involve the construction of a cap, but should be relatively easy to implement. Alternative S-3 would involve the construction of slurry cut-off walls and a cap, both of which are readily constructed. Alternatives S-2 and S-3 should not elicit major public concerns. Alternatives S-4 (In-situ S/S) and S-5 (Ex-situ S/S) should be implementable, however, Alternative S-5 requires extensive waste handling and pre-excavation treatment of soil. Stabilization and disposal are commonly applied technologies for remediating low-level or mixed wastes, and should not

elicit public concerns. Alternative S-6 (Disposal at NTS) would be readily implementable. Alternative S-6 also would require treatment of soil prior to excavation to ensure optimal waste handling characteristics. Post-excavation treatment may be needed under Alternative S-6 for packaging and disposal requirements. There may be potential public concern regarding the off-site transportation of low-level or mixed wastes.

With the exception of Alternative S-6, future remedial alternatives, if warranted, would not be precluded by implementing any of the alternatives. Disposal of LAOCB wastes at the SRS Soil Consolidation Facility, for instance, could be re-evaluated should the facility become operational in the future.

Cost (LAOCB Soil)

Total estimated present worth costs range between \$280,000 for the No Action alternative to \$9,100,000 for Alternative S-6 (Disposal at NTS). Alternative S-2 (\$1,430,000) involves capping only. Alternative S-3 (\$3,430,000) involves slurry cut-off walls. Alternative S-4 (\$3,580,000) involves in-situ stabilization of the contaminated soil. Alternative S-5 (\$4,370,000) involves ex-situ stabilization of the contaminated soil. Alternative S-6 (\$9,100,000) involves *off-unit* disposal of all LAOCB contaminated soil to two feet.

With the exception of Alternatives S-1 and S-6, the estimated operation and maintenance costs of all alternatives are approximately \$430,000 for the long-term (30 years) maintenance of a cap and five year remedy reviews. The estimated operation and maintenance for the No Action alternative (Alternative S-1) is \$280,000 because it does not involve capping. Alternative S-6 would have no additional operation and maintenance costs since it would permanently remove all contaminated soil from the LAOCB waste unit and would not require five year remedy reviews. All cost estimates are provided for comparison purposes only and are not intended to forecast actual budgetary expenditures.

State and Community Acceptance (LAOCB Soil)

Alternative S-1 does not provide short or long term protectiveness of human health and the environment and consequently has not met state and Federal regulatory acceptance. Alternatives S-2 and S-3 do provide for reduced contaminant mobility, however, these alternatives do not provide a permanent reduction in contaminant mobility and have not met state and Federal regulatory acceptance. Alternatives S-5 and S-6 do provide for a permanent reduction in contaminant mobility, however, both alternatives include significant waste handling and/or transport and are estimated in excess of \$4 million. Consequently, neither Alternative S-5 or S-6 have met state and Federal acceptance or community acceptance.

The state and Federal regulatory agencies have accepted and approved Alternative S-4 primarily because it is the least expensive alternative that provides a permanent reduction in contaminant mobility and poses minimal risk to remedial workers and the community. In addition, based on the public comments received from the community and the Citizens Advisory Board, Alternative S-4 has met community acceptance.

Comparative Analysis Summary (LAOCB Soil)

The results of the comparative analysis for the LAOCB soil indicate that with the exception of S-1 (No Action), all considered alternatives are comparable with respect to overall protectiveness of human health and environment, meeting chemical-specific and action-specific ARARs, and relative implementability (see Table 5). The primary balancing criteria are cost, long-term effectiveness and permanence, and reduction of toxicity, mobility, or volume. Alternatives S-5 and S-6, although effective in reducing the toxicity, mobility, or volume permanently, are estimated in excess of \$4 million. In addition, both these alternatives include significant waste handling and/or transport which increase the potential for remedial worker and public exposure. Alternative S-3 has an estimated cost comparable to Alternative S-4, but its ability to reduce contaminant mobility and migration to groundwater over the long-term is not adequate. In addition, although the estimated cost of Alternative S-2 is significantly less than Alternative S-4, its ability to reduce contaminant mobility and migration to groundwater over the long-term is also not adequate.

LAOCB Pipeline Alternatives

Overall Protection of Human Health and the Environment (LAOCB Pipeline)

The No Action Alternative (P-1) would not be protective of human health and the environment. According to data gathered during the RFI/RI, the internal surface of the pipelines exhibit a relatively high radioactivity level (approximately 300,000 dpm on internal surface), however, radioisotopes have not been detected in the pipeline soil or in groundwater from the pipeline areas. This suggests radionuclides have not migrated from the pipeline to unit soil and groundwater. The No Action Alternative does not prohibit access to the pipeline areas, and the potential exists for human or wildlife intrusion and subsequent exposure to the pipelines. Furthermore, based on the shallow depth of the pipeline (within three feet of the ground surface), its relatively high radioactivity level on the internal surface, the age (>30 years) and material of the pipe (steel which could degrade over time and release radioisotopes), Alternative P-1 (No Action) would not be protective of human health or the environment.

Remaining alternatives being considered would all be protective of human health and the ecological receptors. Alternative P-2 would not result in the mitigation of potential future radionuclide release to the environment due to corrosion of the steel walls of the pipelines, however, Alternative P-2 would involve capping, which would: (1) act as a barrier that would deter human access to contaminated media; (2) minimize infiltration and leaching of contaminants to unit soil and groundwater; and (3) act as shielding to reduce radiation exposure to hypothetical receptors to within acceptable levels. Alternatives P-3 and P-4 are protective of human health and the environment because they involve the excavation and disposal of the pipelines.

Compliance with ARARs (LAOCB Pipeline)

The potential chemical-specific ARARs associated with the pipelines include concentration-based standards specified in DOE Order 5400.5. DOE Order 5400.5 is considered TBC information only. The DOE Order specifies an allowable annual effective dose to any member of the public resulting from all DOE operations of 100 mrem/year. The pipelines were not sampled for specific isotopes, therefore it is unknown whether the radiation doses resulting from isotopes in the LAOCB pipelines meet the identified potential ARAR. Consequently, compliance with this potential ARAR cannot be evaluated for Alternative P-1. The remaining alternatives would comply with the potential chemical-specific ARAR through reduction of radiation dose (capping), treatment, or disposal.

Alternatives P-2, P-3, and P-4 would require compliance with several action-specific ARARs. Alternative P-2 involves construction of a cap and would therefore require compliance with RCRA cap performance standards. Alternatives P-3 and P-4 involve construction-type activities and would require NESHAPs air modeling and permitting, an erosion control plan, and an Occupational Health and Safety Administration (OSHA) worker health and safety plan. All alternatives could comply with the action-specific ARARs. No location-specific ARARs were identified under any of the alternatives.

Long-Term Effectiveness and Permanence (LAOCB Pipeline)

Long-term effectiveness and permanence can be measured in broad terms by: (1) the magnitude of residual risks associated with the waste unit; and (2) the adequacy of controls after implementation of the remedial alternative. The alternative having the highest residual risks is Alternative P-1 because the pipelines would remain in place without treatment and institutional controls would not be guaranteed under this alternative. Alternative P-2 would have less residual risk than Alternative P-1 because it would involve capping the pipeline areas which would minimize migration of contamination and would restrict human and wildlife

access to the pipelines. Neither Alternatives P-1 or P-2 would prevent the potential release of contaminants to the environment upon the deterioration of the steel pipelines. Alternatives P-3 and P-4 would result in the least residual risk because they involve removing pipeline contamination from the area.

The adequacy of controls under Alternative P-1 cannot be ascertained since the continued maintenance under institutional controls would not be guaranteed. Alternative P-2 would include the construction of a cap over the pipeline areas which would require maintenance, but would limit the radiation exposure potential, decrease the potential for migration, and limit access to the pipelines. Alternatives P-3 and P-4 involve the removal of pipeline contamination and would, therefore, not require any controls following remediation.

Reduction of Toxicity, Mobility, or Volume (LAOCB Pipeline)

Alternatives P-1 and P-2 offer no form of active treatment and, therefore, do not satisfy the NCP preference for remedial alternatives that offer a reduction in contaminant toxicity, mobility, or volume. However, Alternative P-2 offers capping which would reduce the mobility of contaminants by minimizing surface water infiltration, thereby reducing leaching of contaminants to unit groundwater. Alternatives P-3 and P-4 would offer active treatment through grouting that would reduce contaminant mobility.

Short-Term Effectiveness (LAOCB Pipeline)

The short-term risks to remedial workers increases with project duration. Handling (e.g., excavating, moving) and/or processing (e.g., treating) contaminated media increases the risk of remedial worker exposure to radiation effects. In addition, remedial workers are exposed to potential construction-related risks (e.g., falls, cuts, heavy equipment operation) which increase with corresponding increases in project duration. Potential short-term risks to remedial workers should be manageable for all alternatives being considered. With strict adherence to project health and safety plans, it should be possible to maintain short-term risks of all considered alternatives within acceptable limits.

The potential risk to remedial workers would be lowest for the No Action alternative, followed by Alternatives P-2, P-3, and P-4. Alternative P-2 (capping) would not involve any contact with the pipelines. Alternatives P-3 and P-4 would involve in-situ S/S and excavation and disposal of the pipelines. Alternative P-4 involves more waste handling due to cutting and packaging of the pipeline for transport. The risk to remedial workers would be medium under Alternative P-3 and high under Alternative P-4. Alternative P-3 is estimated to take two months and Alternative P-4 three months.

All alternatives would pose negligible or low short-term risks to the community. The risks posed to the community from Alternatives P-1, P-2, and P-3, would be negligible since they would not include *off-unit* transport of contaminated media. Since Alternative P-4 involves transport of contaminated soil to the NTS facility near Mercury, Nevada, 2,200 miles from the LAOCB waste unit, this alternative involves more risk than the other alternatives.

Implementability (LAOCB Pipeline)

Alternative P-1 (No Action) would be the most implementable alternative being considered since it would not involve any type of construction or remedial actions beyond existing institutional controls. However, the No Action Alternative could potentially arouse public concern since it does not involve treatment or removal of the contamination. Alternative P-2 (Capping) would involve the construction of a cap, but should be relatively easy to implement. Alternative P-2 should not elicit major public concerns since a cap would provide a physical barrier between receptors and the pipelines, however, the geometry of the cap (approximately 450 ft long by 10 ft wide) would cause traffic control and maintenance problems under current and future land use scenarios. Alternatives P-3 (In-situ S/S and disposal in the LAOCB) and P-4 (In-situ S/S and disposal at NTS) could be readily implementable. S/S is a commonly applied technology for remediating low-level wastes and should not elicit public concerns. There may be potential public concern regarding the off-site transportation of low-level waste under Alternative P-4.

Cost (LAOCB Pipeline)

Total estimated present worth costs range between \$730,000 for Alternative P-2 (Capping) to \$4,630,000 for Alternative P-4 (In-situ S/S, excavation, and disposal at the NTS). The cost of Alternative P-1, No Action, would be included under the No Action alternative for the LAOCB soils (S-1). Alternative P-2 (\$730,000) includes capping only. Alternative P-3 (\$990,000) involves the grouting, excavation, and disposal of the pipelines in the LAOCB. Alternative P-4 (\$4,630,000) would involve grouting, excavation, and disposal of the LAOCB pipelines at the NTS.

Alternatives P-1 and P-2 would require a remedy review every five years for 30 years because they do not result in unrestricted use of the pipeline areas. The cost for remedy review would be included with that of the LAOCB soils, depending on the remedy selected for the LAOCB. Alternative P-2 includes the operation and maintenance costs of a cap.

State and Community Acceptance (LAOCB Pipeline)

Alternative P-1 does not provide short or long term protectiveness of human health and the environment and consequently has not met state and Federal regulatory acceptance. Alternative P-2 does provide for reduced contaminant mobility, however, this alternative does not provide a permanent reduction in contaminant mobility and has not met state and Federal regulatory acceptance. Alternative P-4 does provide for a permanent reduction in contaminant mobility, however, this alternative includes significant waste handling and/or transport and is estimated in excess of \$4 million. Consequently, Alternative P-4 has not met state and Federal acceptance or community acceptance.

The state and Federal regulatory agencies have accepted and approved Alternative P-3 primarily because it is the least expensive alternative that provides a permanent reduction in contaminant mobility and poses minimal risk to remedial workers and the community. In addition, based on the public comments received from the community and the Citizens Advisory Board, Alternative P-3 has met community acceptance.

Comparative Analysis Summary (LAOCB Pipeline)

The results of the comparative analysis for the LAOCB pipeline indicate that with the exception of S-1 (No Action), all considered alternatives are comparable with respect to overall protectiveness of human health and environment, meeting chemical-specific and action-specific ARARs, and relative implementability (see Table 6). The primary deciding criteria are cost, long-term effectiveness and permanence, and reduction of toxicity, mobility, or volume. Alternative P-4, although effective in reducing the toxicity, mobility, or volume permanently, is estimated in excess of \$4 million. In addition, this alternative would include significant waste transport which would increase the potential for public exposure. Alternative P-2 has an estimated cost comparable to Alternative P-3, however, its ability to reduce contaminant mobility and migration to groundwater over the long-term may not be adequate. Alternative P-3 provides a reduction in contaminant mobility through in-situ stabilization, removal, and further stabilization/disposal in the LAOCB, is more cost effective than Alternative P-4, and has met state and community acceptance.

IX. THE SELECTED REMEDY

Based on the risks identified in Section VI, the LAOCB soil poses significant risks to human health and the environment. Significant carcinogenic risks to the potential future worker or resident are driven by exposure from direct radiation, ingestion of soil, and ingestion of produce grown in the LAOCB soils contaminated with radionuclides (primarily ⁶⁰Co and ¹³⁷Cs) to a depth of less than two feet. In addition,

significant noncarcinogenic risks are driven primarily by ingestion of basin soils contaminated with chromium and lead. Based on characterization and risk evaluations, a remedial action is appropriate for the LAOCB soil.

An evaluation of potential alternatives was performed in accordance with the NCP as summarized in Section VIII. Based on this evaluation, the selected alternative for remediating the LAOCB soil is Alternative S-4: In-situ Stabilization and Capping. This alternative will meet remedial action objectives by permanently eliminating ingestion of soils and produce grown in soils, eliminating direct radiation exposure, and providing a permanent reduction in contaminant mobility and potential future impacts to groundwater. In addition, this alternative poses minimal risk to remedial workers and the community, is the least expensive alternative that meets remedial action objectives, and has met state and Federal regulatory and community acceptance.

Implementation of the selected LAOCB alternative (S-4) will involve in-situ S/S of the top two feet of soil in the bottom of the LAOCB, the placement of clean soil in the LAOCB, followed by construction of a cap over the LAOCB. Initially, the waste unit would be prepared by abandoning the existing monitoring wells around the basin and clearing any vegetation, fencing, and other physical obstructions immediately surrounding the LAOCB area. In addition, the contaminated soils, vegetation, and debris on the walls of the basin and the staging area on the north end of the basin will be pushed into the bottom of the basin. The soil and debris will then be S/S to a depth of approximately two feet below the current basin bottom. Following S/S, any remaining depression will be backfilled to grade. After sufficient compaction, an engineered cap will be constructed that will minimize infiltration, intrusion, and surface erosion. The treated soil and the engineered cap will minimize surface infiltration and reduce the potential for leaching of COCs to unit groundwater. The design of the engineered cap will be approved by the EPA and SCDHEC prior to construction. The cap will cover an area of approximately 0.5 acres (21,780 square ft). The capped area will be maintained and Institutional Controls will remain in place as long as the waste remains a threat to human health or the environment.

Carcinogenic and noncarcinogenic risks posed by the pipeline soils are due to naturally occurring metals and radionuclides that are typical of SRS soils. However, relatively high levels of radioactivity were detected in the LAOCB pipelines. Although this contamination does not currently represent a risk to human health and the environment, future deterioration of the steel walls of the pipeline could potentially release contaminants to the environment and result in unacceptable risk. Based on these criteria, a remedial action is appropriate for the LAOCB pipeline.

An evaluation of potential alternatives was performed in accordance with the NCP as summarized in Section VIII. Based on this evaluation, the selected alternative for remediating the LAOCB pipeline is Alternative P-3: In-situ Stabilization and Disposal in the LAOCB. This alternative will meet remedial action objectives by permanently eliminating ingestion of soils and produce grown in soils, eliminating direct radiation exposure, and providing a permanent reduction in contaminant mobility and potential future impacts to groundwater. In addition, this alternative poses minimal exposure of remedial workers and the community, is the least expensive alternative that meets remedial action objectives, and has met state and Federal regulatory and community acceptance.

Implementation of the LAOCB pipeline alternative (P-3) will first involve in-situ grouting of the pipelines to minimize the release of residual contaminants from inside the pipeline during excavation. Next, the pipelines will be excavated, cut into manageable sections, and placed in the LAOCB along with any contaminated soils associated with the pipelines. After being placed in the LAOCB, pipeline soil and voids between pipeline sections will be grouted to create a monolith that will further reduce the mobility of pipeline contaminants. As described in Alternative S-4 for LAOCB soils, the remaining depression in the basin will be backfilled with clean soil. After sufficient compaction, an engineered cap will be constructed that will minimize infiltration, intrusion, and surface erosion.

Based on characterization and risk evaluations of the soil in the LAACB, soil along the LAACB pipeline, or soil along the effluent drainage ditch south of the LAACB, the No Action is the selected remedy. No remedial action is required; however, the LAACB will be backfilled with native soil and vegetation will be established in a similar fashion to the clean closure of the F-, H-, K-, and P-Acid/Caustic Basins (WSRC, 1995a). Final grade will be sloped to promote drainage and conform with surrounding terrain. The No Action alternative will be protective of human health and the environment, and no post ROD documentation or reviews will be necessary.

In the long-term, if the property is ever transferred to non-Federal ownership, the U.S. Government will, in compliance with Section 120(h) of CERCLA, create a deed for the new property owner. The deed shall include notification disclosing former waste management and disposal activities as well as remedial actions taken on the site. The deed notification shall, in perpetuity, notify any potential purchaser that the property has been used for the management and disposal of radioactive oil and chemical wastewater. The deed shall also include deed restrictions precluding residential use of the property. However, the need for these deed restrictions may be reevaluated at the time of transfer in the event that contamination no longer poses an unacceptable risk under residential use. In addition, if the site is ever transferred to non-Federal ownership,

a survey plat of the area will be prepared by a certified professional land surveyor and recorded with the appropriate county recording agency.

These selected remedies and the No Action are intended to be the final action for the LAOCB/LAACB source unit. The solution is intended to be permanent and effective in both the long and short terms. These alternatives are considered to be the least cost options which are still protective of human health and the environment. Further assessment of the groundwater contamination will be conducted to define the extent of groundwater contaminant plumes under the comprehensive L-Area Southern Groundwater OU. This assessment will provide the data necessary to conduct a risk assessment, Feasibility Study, Proposed Plan, and ROD for groundwater in the vicinity of the unit. The SCDHEC has modified the SRS RCRA permit to incorporate the selected remedy. This proposal is consistent with EPA guidance and is an effective use of risk management principles.

X. STATUTORY DETERMINATIONS

Based on the LAOCB/LAACB RFI/RI Report and the BRA, the LAOCB source OU poses significant risk to human health. Therefore, a determination has been made that in-situ S/S of the pipeline, excavation and placement of pipeline in the LAOCB, and in-situ S/S and capping of the LAOCB is protective of human health and environment for the residual contamination in the LAOCB pipeline and LAOCB soil.

The selected remedy is protective of human health and the environment, complies with Federal and State of South Carolina requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. The high levels of radioactive contamination in the LAOCB warrant a remedy in which in-situ S/S and capping is a practical alternative. In-situ S/S and capping will result in the protection of unit groundwater through the S/S of unit COCs, and will be protective of *on-unit* human and ecological receptors by shielding radiation exposure and preventing the ingestion of unit COCs.

Based on characterization and risk evaluations, it has been determined that the LAACB source OU poses no significant risk to human health and the environment. A No Action alternative is appropriate for the LAACB and will be protective of human health and the environment. The LAACB will be backfilled with native soil and vegetation will be established in a similar fashion to the clean closure of the F-, H-, K-, and P-Acid/Caustic Basins (WSRC, 1995a).

Section 300.430 (f)(4)(ii) of the NCP requires that a five year review of the ROD be performed if hazardous substances, pollutants, or contaminants remain in the waste unit. The three Parties, DOE,

SCDHEC, and EPA, have determined that a five year review of the ROD for the LAOCB/LAACB will be performed to ensure continued protection of human health and the environment.

XI. EXPLANATION OF SIGNIFICANT CHANGES

The SB/PP and the draft RCRA permit modification provided for involvement with the community through a document review process and a public comment period. A public meeting was advertised and held on May 7, 1997. Comments that were received during the 45-day public comment period (April 4 - May 18, 1997) are addressed in Appendix A of this Record of Decision and are available with the final RCRA permit. There were no significant changes to the selected remedy as a result of public comments.

In selecting the remedy in this Record of Decision, a Savannah River Site bulk disposal alternative was not evaluated in the feasibility study but is currently being developed and evaluated for radiologically contaminated soils/debris as a SDCF. Should the SDCF concept become a Savannah River Site remedial option for radiologically contaminated soils prior to implementation of the selected LAOCB and LAOCB pipeline remedy, then the bulk disposal SDCF alternative will be evaluated for the LAOCB. This evaluation will fully consider the nine criteria established by the NCP in determining if the SDCF alternative is an appropriate remedy for the LAOCB and if the SDCF remedy is determined appropriate for the LAOCB, the change in remedy will cause no significant loss of monetary resources.

Should use of the SDCF concept be deemed appropriate for the LAOCB, this Record of Decision would require modification.

XII. RESPONSIVENESS SUMMARY

There were eight comments received during the public comment period. The Responsiveness Summary (see Appendix A) of this Record of Decision addresses these comments.

XIII. POST-ROD DOCUMENT SCHEDULE

The post-ROD document and implementation schedule is summarized below and is illustrated in Figure 13:

1. Corrective Measures/Remedial Design Work Plan (CM/RDWP) (Rev. 0) will be submitted for EPA and SCDHEC review within approximately 1 month after issuance of ROD.
2. The combined CM/Remedial Design Report (RDR)/Remedial Action Work Plan (RAWP) (Rev. 0) will be submitted within approximately 4.5 months after issuance of ROD.

ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	ORIG DUR	FY97												FY98												FY99											
				M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S							
RECORD OF DECISION																																							
EPA/SCDHEC ROD REV. 1 ISSUANCE		17SEP97	0																																				
CORRECTIVE MEASURE/REMEDIATION DESIGN WORKPLAN																																							
DEVELOP CM/RD WORKPLAN	18JUL97	17OCT97	65																																				
SRS SUBMITTAL OF REV.0 CM/RDWP		17OCT97	0																																				
EPA/SCDHEC REVIEW	20OCT97	3DEC97	45																																				
SRS INCORPORATE EPA/SCHDEC COMMENTS	4DEC97	2JAN98	30																																				
SRS SUBMITTAL OF REV.1 CM/RDWP		2JAN98	0																																				
EPS/SCHDEC FINAL REVIEW & APPROVAL	5JAN98	3FEB98	30																																				
EPA/SCDHEC APPROVAL		3FEB98	0																																				
CORRECTIVE MEASURE/RDR/RA WORKPLAN																																							
DEVELOP CM/RDR/RA WORKPLAN	30OCT97	3FEB98	83																																				
SRS SUBMITTAL OF REV.0 CM/RDR/RA		3FEB98	0																																				
EPA/SCDHEC REVIEW	4FEB98	4MAY98	90																																				
SRS INCORPORATE EPA/SCHDEC COMMENTS	5MAY98	3JUL98	60																																				
SRS SUBMITTAL OF REV.1 CM/RDR/RA		3JUL98	0																																				
EPS/SCHDEC FINAL REVIEW & APPROVAL	6JUL98	4AUG98	30																																				
EPA/SCDHEC APPROVAL		4AUG98	0																																				
CONSTRUCTION ACTIVITIES *																																							
CONSTRUCTION MOBILIZATION	4AUG98	1SEP98	29																																				
CONSTRUCTION START		2SEP98	0																																				
POST CONSTRUCTION RPT/FINAL REMEDIATION PLAN **																																							
DEVELOP POST CONSTRUCTION REPORT	3SEP98	14JAN99	90																																				
SRS SUBMITTAL OF REV.0 POST CONSTRUCTION REPORT		14JAN99	0																																				
EPA/SCDHEC REVIEW	15JAN99	14APR99	90																																				
SRS INCORPORATE EPA/SCHDEC COMMENTS	15APR99	13JUN99	60																																				
SRS SUBMITTAL OF REV.1 POST CONSTRUCTION REPORT		13JUN99	0																																				
EPS/SCHDEC FINAL REVIEW & APPROVAL	14JUN99	13JUL99	30																																				
EPA/SCDHEC APPROVAL		13JUL99	0																																				
** Post construction document dates will be consistent with remediation completion date.																																							

Plot Date 27JUN97

Data Date 30MAY9

3. Corrective Measures/Remedial Action start on LAOCB soils and LAOCB pipelines will begin following EPA and SCDHEC approval of the RDR and RAWP.

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XIV. REFERENCES

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- WSRC, 1996b. *Baseline Risk Assessment for the L-Area Oil and Chemical Basin*. WSRC-RP-95-387, Rev. 1. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC.
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- WSRC, 1997a. *Statement of Basis/Proposed Plan for the L-Area Oil and Chemical Basin and L-Area Acid/Caustic Basin*. WSRC-RP-96-851, Revision 1. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC.
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APPENDIX A

RESPONSIVENESS SUMMARY

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Responsiveness Summary

The 45-day public comment period for the Statement of Basis/Proposed Plan for the L-Area Oil & Chemical Basin and Acid/Caustic Basin (904-83G & 904-79G) began on April 4, 1997 and ended on May 18, 1997. A public meeting was held on May 7, 1997 and a Citizens Advisory Board (CAB) meeting was held on May 13, 1997. Specific comments and responses are found below. The comments are italicized and the responses are bolded. The CAB recommendations are also provided.

Public Comments

Comment 1: No remedial action (No Action Alternative) be performed at the LAOCB and the \$4.6 million be used for remediation of higher risk sites at SRS.

Response 1: A risk assessment for the LAOCB was performed in accordance with CERCLA guidance. The relative risk values for the LAOCB indicate that remediation is required per the statutory requirements of CERCLA. The LAOCB is the second highest ranking unit with respect to risk as defined in the FFA. DOE concludes that there is significant risk to the environment and to the worker because of the following:

- 1) Transuranic Wastes are present in the LAOCB and should be stabilized.**
- 2) The LAOCB is currently open to the atmosphere.**
- 3) Vegetation uptake and mammals, reptiles, and fowl present a current risk of the uncontrolled release of radionuclides from the LAOCB.**
- 4) The potential of adverse weather conditions (e.g., tornado) facilitating the uncontrolled release of radionuclides exists.**
- 5) The LAOCB is the source of existing and potential future groundwater contamination.**
- 6) Even with the exclusion of the risk posed by Cs-137 and Co-60 (>99 percent) at the LAOCB, the risk posed by the long-lived radionuclides (e.g., Pu-239) identified in the LAOCB soils is unacceptable.**

Since the LAOCB poses unacceptable risk and a remedial action is appropriate, a CMS/FS was performed to identify appropriate remedial alternatives. The alternatives were screened in accordance with CERCLA guidance and a detailed analysis of select alternatives, using the nine evaluation criteria, was performed as required by the NCP.

The No Action alternative was fully evaluated and rejected, as presented in the administrative record (CMS/FS), because it would not provide a permanent reduction in contaminant mobility. In addition, The No Action alternative may result in continued groundwater contamination that would require more funding to address than if the source term (LAOCB soil) were remediated.

EPA and SCDHEC have approved the Statement of Basis/Proposed Plan which recommends in-situ stabilization and capping. In-situ stabilization and capping was determined to be the least expensive alternative that would provide permanent reduction of contaminant mobility and meet the statutory requirements of CERCLA.

Comment 2: *Groundwater remediation should be considered as part of the general L-Area groundwater situation.*

Response 2: **An area Groundwater Operable Unit (GOU) is proposed in the current FFA Appendix C and is entitled the L-Area Southern GOU. A schedule for addressing this GOU is currently under development. DOE, EPA, and SCDHEC concur on this strategy of addressing the groundwater as a separate OU.**

Comment 3: *Deed restrictions should be placed on the land records now instead of waiting until some possible future land disposal action by the Federal Government.*

Response 3: **Deed restrictions are not appropriate or needed at this time and would not apply until the property is transferred from government ownership. If the property is ever transferred to non-Federal ownership, a deed will be created and will have deed notification and deed restrictions. As stated on page 16 of 21 in the Statement of Basis/Proposed Plan, the need for the restrictions may be reevaluated at the time of property transfer.**

Public Meeting Comments

The following comments were taken from the May 7, 1997 LAOCB Public Meeting transcript. The following comments are paraphrased from the public meeting transcript during the presentation of the proposed remedy for this waste unit.

Comment 4: *My name is Lee Poe from Aiken, South Carolina, and based on the data provided, my conclusion is that it is unnecessary, as long as institutional controls are maintained at SRS, to spend \$4.5 million on the remediation of the LAOCB. This conclusion is based on the following reasons:*

- 1) The remedial action would expose the workers at SRS to unnecessary risks.*
- 2) The current risk at the basin is minimal and comparable to risks at other areas on and off the site.*
- 3) Delaying an action at LAOCB until there is a decision on the land use in the vicinity of the LAOCB is appropriate.*
- 4) The \$4.5 million that we are talking about spending on this remedial activity should be applied to things at the SRS that have more immediate and real risk than the risk from this basin to some future population that is a tenuous situation at best.*

These comments are consistent with the Mr. Poe's formal written comments on the Statement of Basis/Proposed Plan for the LAOCB/LAACB, Revision 1 (February 1997) submitted to WSRC Public Involvement on April 7, 1997.

Response 4: **See response to Comment #1.**

Comment 5: *My name is Trish McCracken from Augusta, Georgia, and I think it is important to prioritize projects of this nature at the SRS. The cost and spending are very important from the taxpayers' standpoint. If my understanding of the data is correct, the current risk at the LAOCB is low and comparable to many sites across the country. I find it very surprising that Region IV EPA and the State of South Carolina would impose more cost at this site than they do at other industrial sites which probably present the same level of risk. If the regulatory agencies are going to impose these measures at this site, then they should be imposed across the country.*

Response 5: The LAOCB is the second highest ranking unit with respect to risk as defined in the FFA. The FFA has been approved and agreed upon by the DOE, EPA, and SCDHEC. This action is consistent with current environmental laws (i.e., RCRA and CERCLA) that are enforced by EPA and SCDHEC. DOE concludes that there is significant risk to the environment and the worker as outlined in Response #1, and a remedial action is appropriate.

Comment 6: My name is Sam Booher from Augusta, Georgia, and if the decision is to proceed with the backfill and grouting of the LAOCB, I would like to request that DOE give serious consideration to removing the liquids, whether it's rainwater, oil, I don't care what the liquid is, before you pour dirt in there.

Response 6: DOE will consider removal and disposal of the liquids prior to backfilling. These activities will be detailed in the Remedial Design Report and Remedial Action Work Plan.

Comment 7: My name is Suzanne Matthews from Aiken, South Carolina, and I do believe that No Action at this no risk L-Basin is appropriate because the funding is not going to be there. Now speaking maybe for CAB, the CAB is going to emphasize the priority listing of waste units at SRS, and they will support the remediation of high risk waste areas and not the waste areas with low risk.

Response 7: See response to comment 5.

Comment 8: This is Sam Booher again, and I would like to make a suggestion for future public meetings of this type. I would like to have heard at least a brief summary on each of the remedial alternatives considered for the LAOCB before presenting the selected remedy. It seems that of the six considered alternatives, three of them consisted of filling/capping the basin.

Response 8: A detailed screening and summary of all alternatives considered for the LAOCB is presented in the CMS/FS and also presented in the SB/PP. These documents have been approved by EPA and SCDHEC, and are available in the Administrative Record. Radionuclides are unique contaminants with a very limited selection of remedial responses/technologies, with stabilization and containment being the preferred technologies. DOE will in the future provide a brief overview of the alternatives considered at public meetings of this type so that the public may have a better understanding of the rationale for choosing the selected remedies.

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Savannah River Site

CITIZENS ADVISORY BOARD

Recommendation No. 37

May 13, 1997

L-AREA OIL & CHEMICAL BASIN AND L-AREA ACID/CAUSTIC BASIN

Background

The L-Area Oil & Chemical Basin and L-Area Acid/Caustic Basin are within 400 feet of L-Area. They were used as unlined earthen basins for disposal of liquid waste. The L-Area Oil & Chemical Basin (LAOCB) was used from 1961 to 1979 and the L-Area Acid/Caustic Basin (LAACB) was used from 1955 to 1968. Both are located in an area of SRS designated for Industrial Use by the CAB¹ and other Stakeholders². The stakeholders recommended and the DOE-SR plans on DOE maintaining control of all of SRS indefinitely^{1,2}. The LAOCB covers about 0.5 acre, is 12 feet deep and the contamination is confined to approximately the top 2 feet of the soil in the basin bottom. Although some volatile organics and tritiated water probably moved deeper, complete characterization of groundwater contamination has not been done.

Analysis of the risks indicate concern for a future hypothetical onsite resident or onsite industrial worker in the immediate vicinity of the LAOCB only³. These risks are associated largely with direct radiation from Co-60 and Cs-137³. However, there are also risks via ingestion and inhalation pathways. The LAOCB pipelines (about 1000 ft.) contain radioactive materials which could reach the soil after the pipe disintegrates³. Because the pipeline is buried under four feet of soil, there is no risk to the occasional visitor. There are no risks associated with the LAACB.

The preferred alternative³ is a good engineering solution for remedial action. It includes in-situ stabilization, backfilling and capping for the LAOCB, in-situ stabilization of the radionuclides in the pipe, and removal of the pipe and its disposal in the LAOCB. Total costs (not including expenditures for reports and regulatory approval) are estimated at \$4.6 million for the preferred alternative. The risk analysis indicates that no remedial action is needed for the LAACB³.

Recommendation

- The preferred alternative negotiated by DOE, EPA, and DHEC be implemented.³ This alternative includes in-situ grout stabilization, backfill and capping and may reduce the future remediation costs for the groundwater.

1. CAB Recommendations 2, Industrial/Residential Land Use Guidelines for CERCLA Near Term Decision-making, and 8., Nine Part Recommendation on the future uses of the Savannah River Site.

2. Savannah River Site Future Use Project Report - Stakeholder Recommendations for SRS Land Facilities, published by the U.S. Department of Energy Savannah River Operations Office, January 1996.

3. Statement of Basis/Proposed Plan for the L-Area Oil & Chemical Basin and L-Area Acid/Caustic Basin, February 1997.

Savannah River Site

CITIZENS ADVISORY BOARD

**Minority Report
Submitted Regarding
Recommendation No. 37
May 13, 1997**

Two recommendation alternatives were presented to the full Board on May 13, 1997, regarding remedial activities at the L-Area Oil & Chemical Basin. Three Board members were in favor of the following alternative:

Because there is no significant risk under the current L-Area industrial operations, because there is some risk to workers implementing the preferred clean up action, because the area is designated as industrial^{1,2}, because DOE-SR intends to maintain control of the SRS for the indefinite future^{1,2}, because the dominant radiological hazard is associated with radionuclides with half lives of 30 years or less, because groundwater remediation is to be considered later for the whole L-Area, and because the SRS budget continues to decline, the SRS Citizens Advisory Board recommends that:

- The LAOCB be only backfilled with clean dirt at this time. This will provide direct radiation shielding and eliminate possible inhalation and ingestion of contamination by humans. It will also significantly reduce exposure of wildlife to contaminated soil. Costs should be less than the \$1.4 million estimated for backfilling and capping.
- Money saved by implementing this recommended action instead of the preferred action should be used to mitigate risks at higher risk sites.
- Deed restrictions be placed on the land records now to avoid potential conflicts during possible future land disposal action by the Federal Government.
- Groundwater remediation be considered as part of the general L-Area groundwater assessment. If necessary, the LAOCB should be capped with a low permeability barrier later.

Board members in favor of this alternative stated they were concerned that although the L-Area Oil & Chemical Basin is listed as the second highest risk in the Federal Facility Agreement which addresses the Environmental Restoration Program, the basin is not the second highest risk at SRS. Comments were that in light of budget reductions, funding for this activity may be more appropriately allocated to other SRS programs which pose higher risks.

1. CAB Recommendations 2, Industrial/Residential Land Use Guidelines for CERCLA Near Term Decision-making, and 8., Nine Part Recommendation on the future uses of the Savannah River Site.

2. Savannah River Site Future Use Project Report - Stakeholder Recommendations for SRS Land Facilities, published by the U.S. Department of Energy Savannah River Operations Office, January 1996.

3. Statement of Basis/Proposed Plan for the L-Area Oil & Chemical Basin and L-Area Acid/Caustic Basin, February 1997.